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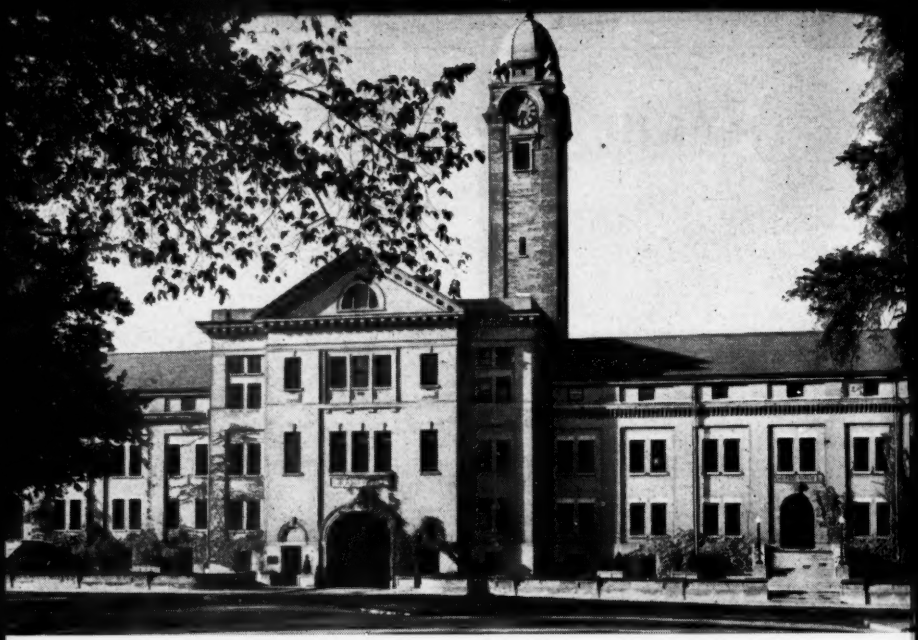

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Ordnance Matériel *for* Aerial Transport

Brigadier General Henry B. Sayler
Chief, Research and Development Section, Ordnance Department

PROBABLY no innovation of World War II—always excepting the atomic bomb—had more significance for future military operations than the movement of troops by air. From the German aerial invasion of Crete to VJ-day, this method of transporting soldiers and their equipment played an increasingly important part in the conflict. Some of the achievements seemed remarkable at the time, but it is apparent now that they were but minor manifestations of the enormously greater mass movements by air that will feature any war which may be fought hereafter. Instead of companies, battalions, or at the most, regiments being flown over comparatively short distances, divisions and their matériel will be airborne to far off destinations. That is not a vision of remote years to come: it is an actuality of today that motivates strategic and tactical planning. It will profoundly influence military activities, and nowhere more intensely than in Ordnance research and development.

Until recently few weapons were designated specifically for transportation by air. Now all matériel must be examined for its adaptability to this requirement. During the last war it was impossible for airplanes to carry in one piece guns larger than the 105-mm howitzer or vehicles bigger than a jeep. Some heavier, longer matériel could be disassembled for transport by two planes. For example, a 2½-ton truck could be ferried by air when it was made into two loads by cutting the frame back of the cab. These expedients caused by the space and weight limitations of even such big airplanes as the B-17, B-24, and C-47 are no longer necessary, save for a very few items of equipment. Before long, transport aircraft will have pay load capacities far exceeding those of present cargo planes.

Even though an airplane can fly when loaded with the most ponderous divisional weapons, more matériel could be transported by an equal number of planes, or the same amount could be carried in fewer planes, if the matériel were lighter and more compact. Recognition of these special requirements for airborne transport influences the design of nearly all Ordnance weapons and equipment. Constant liaison is maintained by the Research and Development Service of Ordnance with the Army Ground Forces and the Army Air Forces to keep informed of the plans and means for mass troop movements by air. Development of matériel then proceeds along lines that will best adapt it to these circumstances.

A decided disadvantage of B-17, B-24 and C-47 airplanes, in addition to their relatively small normal cargo capacity of not more than 6,000 pounds, was the necessity for loading them through the side of the fuselage. Present aircraft like the C-82 "Packet" cargo plane and the Boeing YC-97 "Stratofreighter" can be loaded directly into the cargo compart-

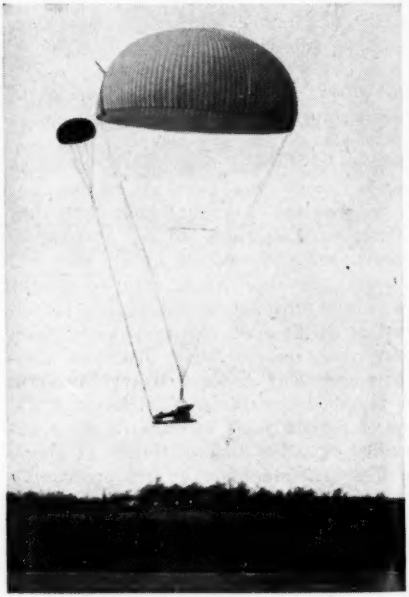
ment from the rear, a method which permits much longer and wider matériel to be installed without disassembly. Almost any divisional matériel can be loaded in such giant craft as the "Stratofreighter," which has a length of 110 feet and a gross

YC-97 "Stratofreighter." (AAF photo.)

weight of more than 130,000 pounds. It is intended that all future cargo planes are to load in this way, thus eliminating one of the difficulties that formerly affected the adaptability of much standard matériel to aerial transport.

Another reason for special design features in matériel is that there are occasions when weapons and equipment must be dropped by parachute. Enemy action or lack of landing fields may make this the only way in which paratroops or isolated units can be equipped. In such an event, matériel must be rugged, light, easily dismounted, and capable of rapid assembly. In many cases, containers must be devised to protect matériel from damage when it lands. Hitherto, it was requisite to drop even so small a weapon as a 75-mm pack howitzer and its ammunition in as many as nine separate loads. Recent Air Force experiments demonstrated that with the aid of ribbon parachutes and no other protection for the piece than a wooden skid fastened under its wheels and trail, a 105-mm howitzer weighing 2,240 pounds can be dropped to the ground without injury to the weapon.

Essentially, the problems common to the design of all matériel for transport by air are those of so reducing weight and size, while retaining all desired military characteristics, that the fully assembled weapons can be loaded in cargo planes. Because there are definite limits in each type of matériel beyond which it is impossible to go in reductions of weight and size, there will inevitably be some weapons which cannot be loaded in their entirety in any existing or immediately foreseen aircraft. When this happens, provision must be made for breaking down the matériel into as many parts as are required for single or multi-plane stowage. This would not be necessary for transport



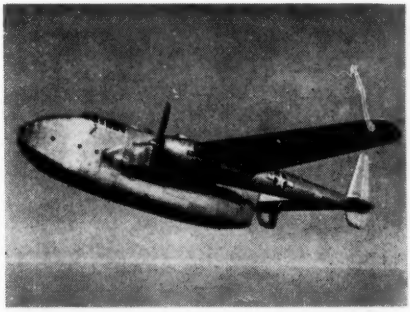
Dropping a 105-mm howitzer by parachute. (AAF photo.)

of any divisional matériel except in the cases of the Medium Tank, M26, the 155-mm Gun Motor Carriage, M40, and the large tank transporters, if a cargo plane with a capacity of 50,000 pounds or more were to be used.

Even though the weight of a certain gun or vehicle may not be too great for a plane to carry, it is possible that the item may be too high or too wide for the cargo compartment. Here, again, making disassembly and assembly quick and simple is a function of design. Another feature to be considered is ground clearance which must be sufficient to prevent matériel from catching on the angle formed by the floor of the cargo compartment and the loading ramp.

Early attempts to transport tanks by air required that they be disassembled, the turret and gun usually constituting one load and the vehicle proper another. Then in 1944 the Ordnance Department produced the first tank definitely designed for air transport. This was the Light Tank, M22, with a 37-mm gun. It weighed approximately 16,000 pounds, completely stowed and with a crew of three men. As a pioneering venture, it opened a new field of tank development which has since been the subject of intense study. Consequently every advisable means is utilized to reduce the weight of tanks so that they may be carried by air. This procedure is also followed in the design of fully armored motor gun carriages. Lowering the weight of such cumbersome matériel may allow two tanks instead of one to be transported by a cargo plane, or enable the plane to carry a completely assembled tank that would have to be broken down and distributed between two planes if it were heavier. When a motor gun carriage is too heavy or too large for loading in aircraft, removal of the armored cab for stowage as a separate load may make the weapon transportable by one or more planes.

Studies of weight reduction in automotive equipment are routine in the design of modified or new models. Though it may not be feasible to lighten frames, axles, and other parts in which strength is vital, weight can be saved in engines, components, and bodies. This can be done both by attention to design and by the use of materials developed during the war which are lighter than steel, but possess the indispensable properties of strength and durability. It is anticipated that future engines, especially those for tanks, will be much lighter than present engines of the same horsepower. Air cooled motors may replace those with water cooling, or, eventually, motive power may be supplied by gas turbines. Ordnance engineers unceasingly pursue their inquiries along lines that suggest saving weight while retaining maximum efficiency in designs.

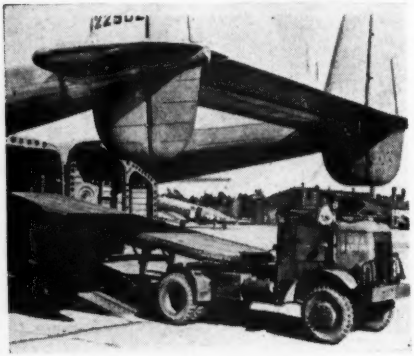


C-82 "Flying Boxcar." (AAF photo.)

Many people seem to believe that the so-called "air age" has brought an end to the need for artillery of traditional design. In commenting on this attitude Major General Everett S. Hughes, Chief of Ordnance, said at a press conference in Chicago: "We don't see the end of anything, but we know that things have changed. We know, for example, that troops of the future will be carried by air, that we won't need a flotilla of 3,000 or 4,000 ships to transport men as we did in World War II." Realization of this momentous revolution in transport and of possible tactical changes which will affect the employment of artillery, evoke new and advanced designs of guns, gun carriages, and fire control instruments.

Some designs may be of better, more powerful, conventional weapons: others may embody radically different principles which will enhance performance.

In the attempt to keep down the weight of artillery, recourse is had to new steels more than twice as strong as those available before World War II and to the alloys developed during the war. Substitution of magnesium and aluminum for heavier metals wherever this is practicable results in lowering the weight of mounts and carriages. Magnesium wheels, trails, and gear housings are experimental



Loading semi-trailer and tractor into C-82. Compare with C-47 in background. (AAF photo.)

adaptations which, if perfected, will culminate in much lighter weapons. Since decrease in the weight of an artillery piece increases recoil and jump, improvements in recoil mechanisms and muzzle brakes must be concommitant developments. Novel methods of suspension may also cut down the weight of gun carriages.

Closely akin to the problems of artillery design are those of rocket launchers. Here the necessity for weight reduction is paramount. Since most rocket launchers are multi-tube devices—some with as many as sixty tubes—the use of light weight materials will lighten the launcher as a whole. Magnesium or plastic tubes assure the desired low weight. When a launcher is mounted on its own wheeled carriage, further saving of weight may be obtained by attention to design and by the use of alloys.

All small arms design is conducted with regard to airborne delivery. The concept of the designer is that the weapon he produces must be as light as he can reasonably make it so that as many as possible may be carried by each plane. With that in mind, the designs of rifles, bazookas, machine guns, machine-gun mounts, and other small arms weapons and equipment, are vigilantly scrutinized to determine how they can be made lighter without impairment of their effectiveness. Bazookas of aluminum, and liberal use of aluminum and magnesium in gun parts and machine-gun mounts, will allow many more of those weapons to be carried in a single plane than could be transported if light weight metals were not used in their construction.

A notable advance in weapons for airborne use occurred with the introduction of the recoilless rifle. The 57-mm recoilless rifle can be fired from the shoulder, and the 75-mm model weighs only 101 pounds and can be fired from a machine-gun tripod; either weapon gives paratroops or infantry the fire power of a conventional artillery piece weighing more than a ton. The compactness and low weight of recoilless rifles permit many more of them to be stowed in a plane than would be possible with wheeled artillery of the same calibers. Recoilless rifles are still new arms of which much may be expected in the future. Development of larger and better guns of this type is a continuing project.

Little can be done to reduce the weight of bullets or of the many kinds and sizes of artillery shells and projectiles. On the other hand, a considerable saving can be made in the weight of small arms and ar-

tillery ammunition components. This is especially true of fuzes and cartridge cases. Plastic or aluminum fuzes can be made much lighter that the fuzes of the past. Successful development of aluminum cartridge cases to supplant those of brass for fixed and semi-fixed rounds of practically all calibers will do much to reduce ammunition weight. The weight saved on an individual ammunition item may seem small, but in quantity it will make a big difference in the total number of items that can be carried by plane.

A great deal has already been done to improve packaging of small arms and artillery ammunition, but attempts continue to secure better protection with lighter weight containers. Research in the use of plastics and light alloys for packaging has been fruitful and is being vigorously followed up. The amount of small arms ammunition that can be transported by a plane can be increased if aluminum ammunition boxes are used instead of those of sheet steel. If these boxes are packed with cartridges having aluminum cases instead of brass cases, a further weight saving can be guaranteed.

These are but some of the ways in which the Ordnance Department is keeping pace with new developments. Our ground forces are now approaching the stage where they can be completely airborne for rapid movement to any threatened area.

We must constantly maintain the nucleus and the pattern of the air-naval-ground-industrial-scientific machine needed in emergency. Else we shall dwell in fear, and forfeit our influence toward a peaceful future. I urge your special concern for air power. Our geographic position makes air power a primary factor in our defense and the best weapon for quick retaliation. It is still relatively new—its potential grows daily. We have a national genius for flying, for maintenance and for production. Our welfare demands that we neglect no part of these three essentials to air efficiency.

* * *

The history of warfare is a constant evolution, with changing weapons and tactics. We are living in a period when the trend moves forward at accelerated pace. No man can picture accurately today, the face or appearance of a possible war in 1967. The outlines, the possibilities, the definite requirements of the present that stand forth with reasonable clarity, take on increasingly haziness the further we attempt to project them against the future. We must avoid stagnation, rigid dogma, complacency; until the need for armaments shall pass, we must be certain that ours are suited to the possibility of their day.

General of the Army Dwight D. Eisenhower

Worldwide
Military Communications

Colonel Haskell Cleaves, *Signal Corps*
Instructor, Command and General Staff College

THE day that war was flung in our faces—7 December 1941—the Army had, on lease, two hundred eight miles of communication lines—one teletype circuit between Washington and New York. In June 1945, the domestic teletype system had grown to 96,000 miles, with 2,600 TWX stations. This system, with the telephone circuits, came to the astonishing total of over 400,000 circuit miles.

For radio, there was a domestic network which extended to the nine Corps Area Headquarters. There was an overseas network reaching to five department headquarters at San Juan, Panama, Honolulu, Alaska, and Manila. This system was barely adequate for the peacetime administrative needs—never designed nor intended to carry the traffic of a global war.

It was a tremendous problem that faced the Chief Signal Officer. All in a hurry—right now—yesterday if possible—everyone had to have communications and lots of them.

The Signal Corps quickly began the activation of a nation-wide teletypewriter network, but was handicapped by the lack of a centralized authority over communications. Various other military organizations and branches ordered facilities. Independent networks, often paralleling and overlapping, sprang up. A computed cost of $608.00 per message was the result of the insistence of one branch chief for a private line to the west coast. All this frantic scramble, totally uncoordinated, threw a terrific burden on operating personnel and equipment of the commercial companies and resulted in an acute shortage of communications equipment.

This was the situation early in 1942, when there was created within the office of the Chief Signal Officer an Army Communications Service, with responsibility for providing adequate, military, fixed communications throughout the world. This service not only had to meet the immediate military requirements which were growing by leaps and bounds, but it had to bring order out of existing chaos, and to begin streamlining the system for the immensely greater volumes of war traffic yet to come.

The Army Communications Service had one vital asset—every commercial communications company in the nation placed its resources, its facilities, and its technical assistance at the disposal of the Signal Corps. The final result of this cooperation was an integrated, high-capacity, high-speed system which crisscrossed the nation and circled the globe.

In September 1943, something that had been needed for a long time was finally placed in the hands of the Chief Signal Officer—a War Department directive giving him complete control over military communications, and thereafter the parallel independent networks were consolidated or eliminated much faster, with the Army Command and Administrative Network absorbing most of the traffic, resulting in

a great saving of time, manpower, equipment, and money. The situation when the war ended was pointed out at the beginning of this article, and is reiterated here for emphasis—from 208 circuit miles in June 1942 to 96,000 circuit miles three years later, a system that carried many hundreds of thousands of words a day of tape-relayed teletype traffic.

So much for the continental United States. The growth of the overseas network was fully as startling. I have given you the situation as it stood at the outset of the war. We had some coverage across the Pacific, but none whatsoever in the Atlantic except to San Juan and a link to St. Johns, Newfoundland. With the desperate need upon us, fanned by the requirements of prosecuting a war actually on our hands, expansion was rapid, and by August of 1945, we had the world literally belted with many circuits of different kinds, so that reliable and rapid communications could be had to all commanders in all theaters.

Figure 1.

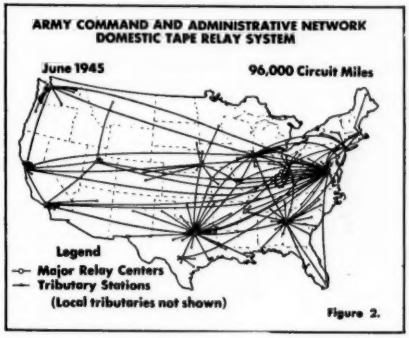


Figure 2.

Technological advances kept stride with this expansion so that we got more return in the form of capacity on the existing circuits. Few of these circuits were permitted the expensive and inefficient luxury of carrying only one channel of voice or teletypewriter conversation. By pulse-time spacing, several conversations were introduced onto the same circuit without mutual interference, and were taken off at the receiving end by the same process of synchronization. By combining the most desirable features of the multiplex teletype system as developed by our commercial companies with the high-fidelity radiotelephone circuits in the VHF (very high frequency) range, an incredibly reliable system of radio-teletype was established. This system became the workhorse of the Signal Corps in its mission somewhat as the faithful C-47 became the workhorse of the Air Transport Command.

At first this radio-teletype was limited in its traffic-carrying capacity to manual operation, and even with the most competent high-speed men, working for short periods and with frequent relief, the mechanical capacity of the circuits from a technical point of view did not begin to be approached. Tape transmitters were therefore introduced. By this means, several manual operators, working at different tape-perforating machines, prepared tapes which were then fed into an automatic transmitter that operated at speeds up to sixty-five words per minute. In this way, the most efficient use of the circuit was attained.

In another step to improve the efficiency of the service, automatic relay equipment was installed at key transfer points, thus obviating the former delay inherent in manual transfer at these points. Under

the old system, at such a point, a message had to be received and recorded by hand or tape, and then re-transmitted. Under the new system, it was exactly the same as plugging through a circuit on a telephone switchboard. A message being transmitted from Washington to Cairo, for instance, via relay points at San Francisco, Honolulu, Guam, and Brisbane, would be instantly received at its destination.

With this round-the-world belt, instantaneous shifting to alternate routes was effected in case of any mechanical or other difficulty on the normal routing. In the case cited above, assume that static conditions were prohibitively bad over the Pacific routing. A switch would immediately be made to the Atlantic circuits and our conversation would be going, possibly, via Bermuda, the Azores, Algiers, etc.

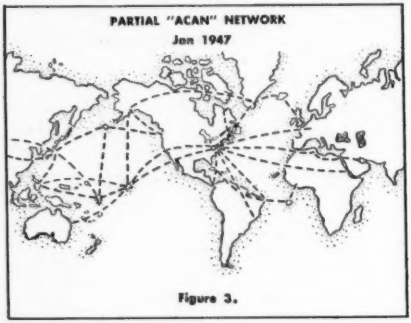
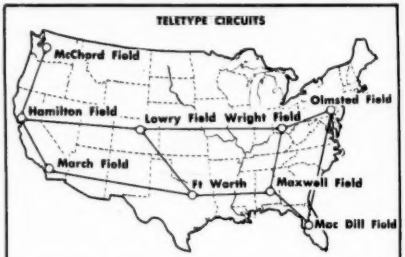


Figure 3.

The security of these communications was unimpeachable as they were cryptographed automatically in a non-repeat cipher system.

An example of the tremendous value of reliable high-speed communications occurred during the second Quebec Conference in 1944 when the Combined Chiefs of Staff were trying to decide whether General MacArthur should advance his attack on Leyte up to 20 October instead of the original date, 20 November. General Marshall said he would find out. He walked into the Signal Control Center right there in the Chateau Frontenac, asked the operator to contact Hollandia and get General MacArthur to the machine. The question was put, and the answer came right back, "Yes!" General Marshall was back in the conference room within five minutes after he had left, with the answer they wanted.

Later, there was further refinement and convenience to this system. It was developed to the point where the message being handled, either incoming or outgoing, appears on an illuminated screen, letter by letter, so that a number of conferees at one station can see the information simultaneously. Also, several machines in different parts of the world can be put on the circuit at the same time, and the message being handled makes simultaneous appearances on the screens of stations participating. At the first annual meeting of the Army Signal Association held at Fort Monmouth, New Jersey, on 29 April 1947, an excellent demonstration of this phenomenal hook-up was presented with stations reporting from Washington, Frankfurt, San Francisco, Panama, Honolulu, Manila, and Tokyo. At the Monmouth terminal, the message was flashed, letter by letter, on the full-size screen of one of the movie theaters.



Teletype Circuits connecting AAF Military Flight Service Communication Center
Figure 4.

What is the peacetime outlook for this magnificent system? A memorandum from the Chief of Staff, dated April 1946, places

on the Chief Signal Officer the responsibility for the installation and operation of a single integrated domestic and overseas military communications system to be known as the Army Command and Administrative Network—familiarly abbreviated to ACAN. A Communications Advisory Board is created consisting of the Chief, Army Communications Service and the Communications Officer of the Air Force. The Chief Signal Officer is designated as the single contracting agency for obtaining services from the commercial companies, a notable provision making for an efficient, integrated system. The Chief Signal Officer is also designated to defend all needs for funds for communications services, including those of the Air Force, and to procure all common items of equipment and supplies. Thus the stage is set, and the ACAN will be limited only by budgetary and personnel considerations. The technical equipment and the administrative organization are on hand. Present indications are that this network in its final form will include approximately 30,000 circuit miles in the United States in addition to overseas facilities.

The Air Force

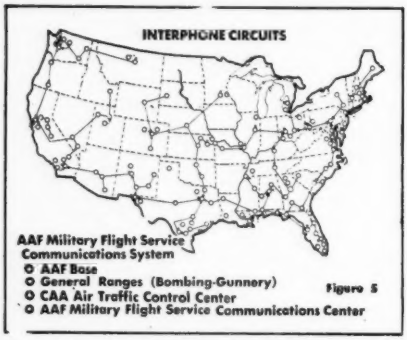
Now for a look at the communications of the Air Force. The inherent characteristics of Air Force operations, with the ever increasing rate of speed and longer ranges of aircraft, both piloted and pilotless, plus strategic types of long-range guided missiles, demand most rapid, flexible, and efficient communications. In the Air Force, radio is considered the primary means of communications for all purposes, augmented by wire circuits wherever practicable as operations progress. Radio and radar are also considered the primary and almost sole means of providing aids to air navigation. Due to the extremely long ranges of strategic type aircraft, it is imperative that a single coordinated procedure be used so that control over a very wide area, involving a large number of interconnected ground stations, can be effected properly. In this matter, the communications problems of the Air Force more nearly parallel those of the Naval Surface Forces rather than those of the Ground Forces.

The Airways and Air Communications Service, normally abbreviated to AACS, is the agency responsible, under the direction of the Commanding General, Air Force and the Commanding General, Air Transport Command, for a continuous and integrated system of airways communications service along military air routes. Those communications services provide facilities for point-to-point, air-ground-air, airdrome control, and meteorological communications; they also provide necessary associated cryptographic sections and message centers, direction-finding and instrument approach-landing facilities, radio and radar aids to air navigation, and military air traffic service established to provide for the safe and expeditious movement of air traffic, not including operational, within airdrome control zones and approach control zones, and along designated controlled air routes.

The AACS handles all message traffic pertaining to the movement and operation of all military aircraft, except those actually engaged in combat operations, and the collection and dissemination of information as required by the Air Weather Service. Where airways circuits are provided for this purpose in remote locations and where other operational and administrative circuits are not warranted as parallel facilities, these circuits may also be used to fulfill these latter requirements by special arrangements in each case. In such case, it is normal for the airways circuits to be multi-channeled so that combat, intelligence and administrative circuits can be allocated to other users as may be necessary.

This AACS service is provided to and between overseas bases chiefly by radioteletype, backed up by manual radio for

emergency. The AACS chart of August 1945, showing service outside the continental United States, showed links along the regular routes of flight, from San Francisco to Honolulu, on to Kwajalein, Guam, the Philippines, Australia, to China, India, Egypt, and other points. Eastward from New York were circuits to Newfoundland, Labrador, Greenland, Iceland, and the United Kingdom. From New York, also, were links to Bermuda, the Azores, French Morocco, France, Algeria, Tunis, and Egypt, completing the round-the-world belt. Another important coverage is the Carribbean area and the South Atlantic—Brazil, Ascension Island, and the west coast of Africa, to handle air operations in that part of the world. The


INTERPHONE CIRCUITS
AAF Military Flight Service Communications System
AAF Base
General Ranges (Bombing-Gunnery)
CAA Air Traffic Control Center
AAF Military Flight Service Communications Center
Figure 5

latest chart shows an important and significant addition to those mentioned, from Alaska across to Greenland, an exceedingly valuable link to provide weather information and flight control in that hazardous region. There are links from Guam to Adak on the tip of the Aleutians and from Honolulu to Fairbanks, Alaska, for the exchange of weather information in those regions. From each of these centers, there are local links to satellite bases for local information and flight control.

Within the continental United States, the Army Air Forces formerly used the network of the Civil Aeronautics Authority, but during the war, with the astronomical increase in the volume of military air traffic, the CAA nets became greatly overloaded and at times were as much as twenty-four hours behind. For weather information and flight control, this situation was worse than none at all, so the Army had to establish a system of its own. The backbone of this network is a wire teletype system connecting the nine Air Force Military Flight Service Communications Centers.

Each of these centers is the control point for a ground wire Interphone System. By this means, weather and flight information is passed to fields within the sector of the center. At each field, this circuit normally has three outlets—at the control tower, the base operations office, and the radio station. Each of these locations is provided with a loud-speaker in addition to telephone equipment.

I have shown how this wealth of information is spread among ground stations. Now, how is it transmitted to pilots in the air? There are several nets for this purpose. The first is the Army's own VHF radio network with some sixty-odd stations scattered throughout the United States and so spaced that they are able to cover the ordinarily-travelled routes. This net operates on a uniform frequency of 137.00 megacycles and over it the pilot gets his latest flight information, landing instructions, etc.

The CAA also has a complete VHF coverage, more so in fact than the Army. This net operates on 116.1 megacycles and all military planes have this crystal installed in their sets so they can at any time tune in on it. Hourly weather broadcasts are a feature of this net.

In addition, there is a military HF net, with a common voice and key frequency for the entire United States as well as a special voice frequency for each of three zones whose north-south boundaries roughly divide the United States into three equal parts.

At thirteen points on the ocean-bordered perimeter of the country are High Fre-

quency Direction Finding stations, established chiefly to furnish pilots coming in from out at sea with accurate orientation.

These rather extensive systems I have outlined are not completely military-owned or constructed. Practically all the landlines are commercially-owned and leased by the War Department. To make a success of such an arrangement, it goes without saying that the closest of cooperation and understanding must exist between the office of the Chief Signal Officer and the commercial operating companies. This does exist and has existed for a number of years, a relationship between government agency and private enterprise that has paid large dividends in terms of the finest and most efficient communications systems the world has ever known.

Production figures for Signal Corps equipment during the war years totaled more than 6 1/2 billion dollars. Some of the major items procured during 1945 alone were 5 1/4 million miles of wire, almost a million telephones, and a half a million radio sets. A quartz crystal industry was virtually created overnight and the domestic production of these tiny wafers, indispensable to radio communication, rose from 100,000 in 1941 to a rate of 36 million in 1945.

Armed Forces Talk

Feb 1948

America's first line of defense is not in its Army, Navy, or Air Force; it exists in the minds of its people. It is expressed in their willingness and capacity to understand and to help shape the events which determine the course of our future conduct. The 350 billions of dollars we have already spent on World War II should have proven to the American people that economically, it is far cheaper to prevent wars than to fight them. If the American people will support an adequate force for the common defense—and if the American people will employ their economic strength as a positive force for peace, we can circumvent the dangers of war before they become a hazard.

General Omar N. Bradley

Infantry in Mountain Operations

Lieutenant Colonel B. C. Chapla, *Infantry*
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ALTHOUGH mountain fighting is actually as old as war itself, the training of units in the continental United States prior to 1940 was intended primarily for action in open, rolling terrain. Startling developments during the earlier phases of World War II brought the importance of mountain operations into sharp focus. In 1940, the Finns, veterans of mountain winter warfare for centuries, gave a notable account of themselves against superior Russian forces. The Germans successfully conducted large scale operations in mountainous country and routed the defenders of Norway, Yugoslavia, Albania, and Greece in turn.

Our own armies were soon to gain firsthand knowledge in mountain operations. We suffered defeat in the Philippines when the Japanese moved successfully through the Zambales Mountains. The North African campaign, and the earlier phases of the Italian campaign, added to our knowledge of mountain operations. The special problems encountered up to the Italian campaign seemed to require a degree of specialization beyond that of the standard units which had been engaged. The 10th Mountain Division was, therefore, activated and specially trained in the zone of the interior for mountain combat.

The division saw its first action in the rugged Apennines of Northern Italy in February 1945. Here it was engaged alongside standard infantry units which had had varying degrees of mountain experience. The 34th Infantry Division had been in combat since the fighting in Tunisia in 1943. The 85th and the 88th Infantry Divisions had been fighting in the rugged mountainous Italian terrain since March 1944. The 91st and 92d Infantry Divisions also had seen considerable action in Italy.

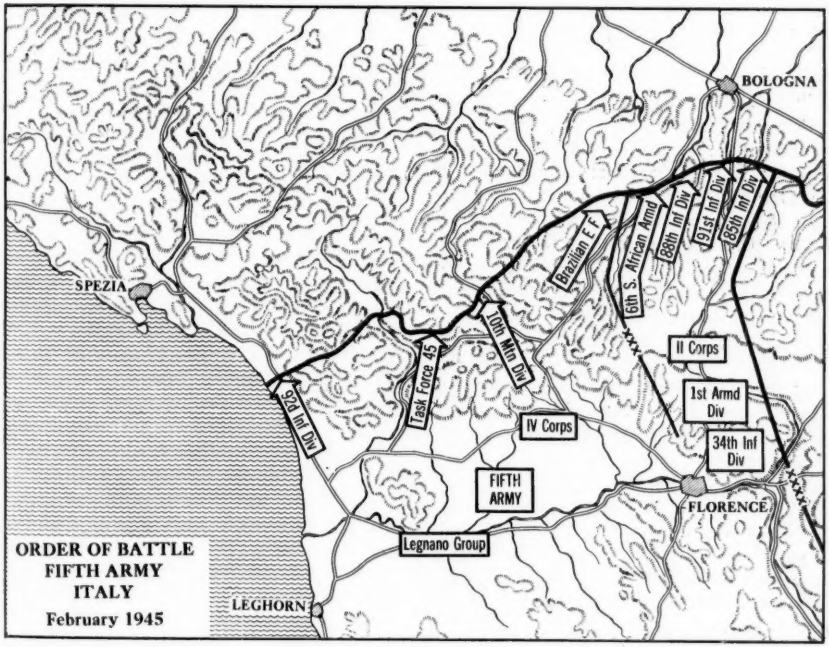
Italy provided an excellent opportunity to study the special training, tactics, and equipment required in mountain operations. The Apennines, in which most of our mountain fighting was done, are comparable to the Alps in ruggedness. While the special mountain units performed some tasks with greater ease than standard units, the fact remains that both fought successfully over identical terrain. The standard units found that some special equipment and training was a help, but on the other hand, the 10th Mountain Division discovered that, in the changing situations which confronted it, some standard equipment was more desirable than the special equipment initially issued.

Since that test in the Apennines, the 10th Mountain Division has been deactivated and there are no plans in the postwar army for a mountain division. Since any future employment of such a division is a matter of considerable speculation, it seems reasonable to expect that standard infantry divisions, sufficiently trained and equipped for rapid conversion to mountain combat, will be employed.

Mountain Combat, A Special Operation

If we are right in assuming that the standard infantry division is destined to perform the bulk of mountain fighting in a future war, it is logical to expect that all infantrymen should be well-grounded in this type of special operation. They must have special training and must be fully prepared to overcome the chief obstacles, terrain and weather. The exaggerated terrain features characteristic of mountains, the heavy woods, jungle, glaciated peaks, compartmentation, and restricted routes of communication are factors which affect all phases of these operations. Movement is restricted, fires are obstructed, maneuver is impeded, communication is hampered, and logistical support is seriously handicapped.

Another characteristic problem is brought about by the change of altitude. There has been much misunderstanding about the effects of change of altitude. Abrupt changes of several thousand feet undoubtedly affect all soldiers engaged in strenuous marches or fighting. However, the Mountain and Winter Warfare School and Training Center expresses the belief that if the change is not abrupt, practically all individuals can adjust themselves to any altitude where ground military operations may take place.



Troops can acclimate themselves to mountain weather also, even though this weather, both winter and summer, is apt to be inclement. There are sudden rains and snow storms, thick fogs, strong winds, and temperature extremes. Ernie Pyle, writing on the Italian campaign, said, "The war in Italy is tough. The land and weather both are against us. It is the *weather* and the *terrain* and the *weather*."

Though these obstacles of weather and terrain have adverse effects on operations, they may, on the other hand, be a valuable aid if they are properly understood, and if advantage is taken of them. For instance, with the aid of short range weather forecasts, a commander may make use of a thick fog to enable him to approach an enemy position undetected and with a minimum of casualties. In some other situation he may postpone an operation on the strength of reports forecasting a sudden snow storm.

We should fully realize the extent to which mountain terrain and weather increase the difficulties of supply. The overall number of troops employed and even the type and time of small unit operations are much more dependent on logistical factors than in operations in other terrain. Constant and continuous coordination between G-3 and G-4 is therefore necessary. These considerations emphasize the necessity for early decisions, so that either the supply build-up will surely meet the requirements, or the lack of adequate logistical support will be recognized before committing troops to a plan of action.

Logistics

In mountainous terrain, troop movements are a special problem. Not only is progress slower but time and space are extremely difficult to estimate. While it has been indicated that practically all troops are able to acclimate themselves to high altitudes, the pace of operations slows down as the altitude increases. Moreover, every individual will have additional items of equipment to carry. Organizational needs may have to be transported without vehicles. Some supplies may have to be mule-packed, but a great deal may have to be man-carried. Consequently, there is the problem of heavier man loads and decreased physical ability. To add to the difficulties of movement, there will always be the question of reliability of map distances which will require the use of special time factors for estimating time and space.

Routes for movement are another consideration. Generally there are improved roads in the valleys, but only trails on the ridges. The use of roads without securing the high ground on both sides invites ambush and casualties, while the use of ridge trails involves movements which are exposed to observation and artillery fire. In an uncovered approach it is usually necessary to move along the sides of the ridges to secure concealment. Multiple routes are used when available, but because of terrain obstacles between them, columns are not mutually supporting during much of the time. Marching personnel are exposed to freezing and readily become fatigued by trail-breaking and wallowing through mud, snow and ice. Motor movements are restricted to hard roads, and make heavy demands on engineer units, which in many cases must be assisted by other troops to develop and clear the necessary roads. Some situations demand night marches. They are possible but dangerous, and necessitate daylight reconnaissance, route-marking, and guides.

Oversnow vehicles may be provided when other vehicles cannot move, but they are not well-suited for the hauling of heavy loads or large numbers of men in deep snow. They are usually best suited for short movements.

There is still another complication in the movement of troops and supplies. When road capacity and means of transport are limited, the amount of some supplies will be increased over that needed for combat in more usual types of terrain. The total tonnage of supplies required in a division will be decreased, but the supplies needed by individual soldiers will be increased. For example, there is an increased consumption of food resulting from increased expenditure of energy. There will be some additional or special

items of equipment and weapons. Some of the equipment, for example, consists of extra clothing, sleeping bags, and individual cooking and heating facilities. In special situations, non-standard weapons and transport will be required. Extreme weather conditions and special equipment requirements increase the consumption of fuel, lubricants, and anti-freeze solution for vehicles. To increase logistical planning difficulties further, there is the matter of transporting and storing excess equipment. Excess supplies reduce the efficiency of the individual soldier and seriously impede operations in general. Consequently, those items which may become excess as the situation changes must be determined, and provision must be made to collect, store and guard them until needed again.

Tactics

The factors of terrain and weather that complicate the movement of supplies and troops affect the conduct of battle in general. Principles of combat do not change with terrain, but the terrain has a definite influence on the technique of application of principles. In the offense, compartmentation tends to divide the battle into many more or less isolated conflicts which are difficult for the higher commander to control. Mountain combat, therefore, requires subordinate commanders with a high degree of initiative, determination, and leadership. Because of the isolated nature of these operations and the difficulty of communication, decentralization is forced upon the commander. Small units are given attachments of artillery and other supporting arms which in open terrain are usually held under central control. However, there should be as much centralized control as is feasible. In situations involving decentralization under conditions of open terrain, normal type orders are used, but in mountain combat it is necessary to go into considerable detail in order to insure proper coordination, control, reinforcement, and communication with subordinate units. In the division field order, we find details as to *how* a subordinate unit will accomplish its mission. Moreover, the attack plan should emphasize objectives and routes of advance rather than boundaries.

Ridges are the important terrain features and will most frequently be fought for. Fighting along ridges and commanding ground will make the assignment of successive objectives habitual. Although they may diverge initially for subordinate units, they converge on the final objectives. The objectives are usually terrain features such as passes or communication centers, or the heights which control these features.

Just as in open terrain, in mountain combat we prefer to attack enemy positions by flanking action. Frontal attack against defended heights has little chance of success. When flanking action is impossible, a night attack may be the preferred method. Such an attack should be launched quietly and stealthily, without initial supporting fire. Upon reaching the proximity of the enemy, and as soon as there is sufficient daylight, the infantry commander may direct observed fire on enemy positions.

In deep snow, envelopment by a properly equipped force offers good prospects of success. Bodies of troops specially equipped and trained in oversnow movements may be operated as a major force. However, during such operations a change of weather conditions such as a heavy snow or a sudden thaw may prevent completion of a cross-country movement and impose a situation wherein the maneuvering troops will be cut off from adjacent friendly forces. Not only must special arrangements be made for the compilation of frequent weather reports, but the plan of operations must be flexible so that it can be adapted to changes in the weather. Fogs develop quickly and low clouds may

obscure observation, so that combat aviation is restricted in its employment against hostile artillery reserves and installations.

In defense, the organization of the ground, organization of fires, and tactical organization is similar to that used in open terrain. Dominant heights give the defender superior observation while denying it to the enemy. In addition, slopes and other terrain features impose difficulties on the attacker, and the meagerness of the road net restricts the use of armor. The battle positions consist of defense areas on important terrain features organized for all-around defense with mutual support and depth of position. Fires across the entire front are prearranged, because no area can be considered impassable to ski mountaineers. Gaps between adjacent defense areas are protected by shuttling patrols, by placing connecting groups, strong in automatic weapons, on intervening ground and by organizing dominating terrain in the rear. Continuous surveillance must be maintained throughout the sector. Ambushes and a complete system of protected road blocks are an integral part of the defense.

In the conduct of the defense, there is the difficulty of maneuvering reserves and shifting fires because of the compartmentation of the ground. Grazing fire may be impossible, and the terrain will generally offer defilade for surprise attacks by the enemy. The defender must be prepared to counter any initial success of the attacker by keeping his reserves mobile, well forward, and near the probable scene of employment. Details for the emplacement of the reserve are set forth specifically in advance.

Training

Efficiency in fighting and supplying troops in mountain operations requires appreciation of the many peculiarities of such combat. To achieve the desired degree of efficiency, there must be special training for commanders, the staff, and the individual soldier. After-action reports of infantry units which have engaged in mountain combat contain many remarks concerning the necessity for such training. Particularly, they highlight the need for physical hardening to be carried out at altitudes and in terrain similar to that in typical mountain situations.

One object of training is to convince the soldier that he can move over seemingly impassable terrain. This includes instruction in rock climbing techniques and in the use of pitons and other paraphernalia of the mountaineer. The aim is to make semi-trained climbers. The psychological aspect is important since the average man who has not had experience in mountain climbing regards it with alarm. Basic confidence of the soldier in his ability to move over the exaggerated terrain features must be established.

Special instruction in the employment of weapons under mountain conditions is needed. This includes not only experience in firing all weapons to determine their capabilities and limitation, but also the maintenance of these weapons in extremes of weather.

Special training recommended for an infantry division by the Mountain and Winter Warfare School and Training Center is as follows:

(1) Movement:

(a) The use of skiis and snow shoes.
(b) Rock climbing technique.
(c) The use of oversnow vehicles.
(d) The use of animal transport.

(2) Survival:

(a) Principles of summer bivouacking.
(b) Principles of winter bivouacking.
(c) Preparation of individual rations, summer and winter.
(d) Use of special clothing and equipment, summer and winter.

(3) Supply:

(a) Use of air supply.
(b) Use of animal transport.

(c) Use of oversnow and general purpose vehicles.

(d) Use of pack boards for individual back pack.

(4) The application of tactical principles to mountains:

(a) All of the above factors must be considered in the application of tactical principles to mountain and winter warfare.

(b) Added importance of terrain evaluation.

(c) Organization and plans for more independent action of units.

(5) Employment of weapons:

(a) Understanding of capabilities and limitations of weapons in mountains and in deep snow.

(b) Maintenance of weapons in firing condition during extreme cold.

The objective is to arrive at such a standard that the entire unit can move, maneuver, supply itself, and survive in rugged country and in conditions of deep snow and extreme cold.

There is some difference of opinion as to the length of time necessary to accomplish the training objective. The Mountain and Winter Warfare School recommends a three month training period for a standard infantry division.

In further considering the question of the necessary amount of training, we must include sufficient time to give the standard infantry division an opportunity to operate as a unit under conditions for both winter and summer combat with the necessary modifications of equipment.

Modification of Standard Infantry Organization and Equipment

A detailed examination of our present Tables of Organization and Equipment to determine what modifications are necessary for the various situations presented in mountain combat would necessarily be quite lengthy. It would result in conclusions based only on current tables of organization and equipment and in such specific localities as might be considered. Conditions vary so widely in mountainous areas, that for each campaign, special decisions on clothing and equipment have to be made. The standard matériel which can or cannot be employed, and the special equipment which will be needed have to be determined, based on the road net, the terrain, the time of year, the transport available, and enemy capabilities. For example, in Italy the road net and terrain permitted the employment of some tanks; hence, enemy capabilities demanded that antitank weapons be included in our arms. If the enemy is without armor in other mountainous areas with a less developed road net, these weapons might not have any practical use.

With regard to transport, it is safe to assume that a division's normal means of carrying supplies by the 2½-ton truck will undergo modification. In most cases, the 2½-ton truck can be used for logistical purposes from army installations to division supply points. These, no doubt, will be established as far forward as possible. The ¼-ton truck can be used extensively, if necessary, for hauling supplies over trails and roads impassable to the 2½-ton truck between division and regimental supply points. For purposes of supply and evacuation, the ¼-ton truck and the pack mule will be used to battalion distributing points. Man-carry may be the chief means of reaching the individual soldier in the line. Oversnow vehicles, sleds, and toboggans may be used.

Use of air supply should be anticipated, particularly for emergency resupply, and the detailed planning necessary should be accomplished early.

All these variations from the normal will have to be covered in training the standard division.

In addition to modification of transport, there may be substitution of weapons for some of those normally used in a standard division. Almost certainly there will be

some substitution of pack artillery. One or more of the three light battalions may use pack weapons. Some of the tanks of the regiment may be considered excess. The heavier infantry mortars and machine guns may be regarded as excess or they may be replaced by lighter weapons. Grenades, demolition materials, sub-machine guns, sniper rifles, and recoilless weapons may be in greater demand.

Accompanying the changes in the organization of the standard division for mountain warfare will be a readjustment of personnel strength. The proportion of engineers and service troops must be higher because of increased need for supplies and because of the increased seriousness of the consequences of supply failures. Vehicular reconnaissance troops and the organic tank battalion will generally be inoperative in deep snow. On the other hand, more medical personnel must be assigned to provide for the increased number and size of collecting parties, increased non-battle casualties, and increased duties in providing veterinary service for animals. Finally, there is a need for a staff of experts and a cadre of troops who are native to the region or a similar region, to be attached to the division as advisors, trainers and scouts. For example, a platoon of expert ski troops to be used as reconnaissance troops in deep snow may be very desirable.

The general rule is to keep modifications at a minimum for the particular needs of any operation. Commanders and staffs should, however, anticipate the difficulties to be expected, and they should be well-versed in satisfactory means of coping with the problems that may confront them.

With understanding and full appreciation of the modifications and adjustments that must be made to fit a unit for mountain combat, and an intelligent approach of the command responsibility in preparing the unit, a standard infantry division can be satisfactorily prepared to cope with all the contingencies involved in such combat. The standard infantry division, organized as the versatile combat unit, prepared basically for the hard hitting shock action of battle with a field army, is well adapted for rapid conversion for large scale mountain operations.

Each new technical development means more for the soldier to learn. It is of the utmost importance that we have a citizenry trained in the skills of technical, modern warfare.

Major General John W. Leonard

Military Psychology—Analysis of Mental Ability

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This is the fourth in a series of six articles on military psychology by Major Sylvester and Chaplain (Maj.) Longley.—The Editor.

MENTAL ability is one of the most important factors to be considered in the classification and assignment of men. To the Army goes the distinction of having been a pioneer in the field of the measurement of mental ability by means of group testing. Prior to World War I, tests of intelligence were individually administered, principally in clinical situations. When the United States entered World War I, the task of examining two million men obviously demanded a new technique in testing. The famous Army Alpha and Beta tests were the result of the concerted efforts of a group of psychologists working with the Army. These tests, the Alpha for literates, the Beta for illiterates, were the prototypes of the avalanche of group tests which descended on students in schools and colleges, on workers in industry, and on applicants for jobs.

In World War II, ten million men were examined by means of the Army General Classification Test. In this respect, World War II had a tremendous impact on the Army's procedures in the management of its personnel. Technological demands in the recent war far exceeded those of World War I. Specialist skills in the closing months before VJ-day outnumbered those in demand in 1942. In these postwar years, the Army is placing a premium on mental ability; more specifically, it is desirous that its personnel meet certain quantitative, minimum standards in intelligence, leadership potential, and emotional stability.

The Nature of Intelligence

The Army employs the term "general ability" rather than the more popular term of "general intelligence." It conceives general ability, as measured by the Army General Classification Test, to be the "capacity to learn" or to absorb training. Many psychologists have defined intelligence as "an ability to adapt oneself to new situations; to carry on abstract thinking; or to criticize one's own behavior." Adaptability as used here refers to intellectual adaptability, not to an emotional state. There is no assurance that the soldier who is highly intelligent will be a stable individual under the stress of combat.

The terms "intelligence" and "mental ability" have been used interchangeably. Actually, the latter term is the more meaningful to the military commander. A soldier has many abilities, of which mental ability is one. It seems evident, based on much research, that there is a common factor of intelligence which is present in many of the abstract abilities a man might possess. The ability to draw, however, seems to have no correlation whatever with intelligence; neither has

the ability to sing, to perform mechanical tasks, or to engage in physical activities.

Is there a difference between ability and capacity? The distinction is important. An ability is a skill the soldier has acquired; a capacity needs training. An aptitude is a potential ability; with training it can become an ability. It carries the same meaning as capacity. What are the practical aspects of selection and training with regards to a soldier's capacities and abilities? What can the Army expect to receive in the way of these qualities from the manpower resources of the nation? What means are available to measure a soldier's ability to absorb training?

Distribution of Mental Ability

Although only a little less than one-tenth of the total population of the United States was under arms in World War II, this enormous sample differs from the national population of the same age and sex in several ways. Men who were physically and mentally disqualified are not included in the data below which shows the distribution of mental ability in the Army. Men with dependents, essential jobs, and other deferred personnel are not included; neither are some three hundred thousand National Guard, Reserve, and Regular officers. (The test scores of approximately sixty-eight per cent of the total commissioned personnel, who were former enlisted men, have been included.)

In an average civilian population sample the distribution of intelligence follows a symmetrical normal distribution curve. In terms of an Intelligence Quotient (I.Q.), with one hundred as the midpoint or average, there will be as many people below eighty as there are above one hundred and twenty; there will be as many feebleminded individuals (with an I.Q. below seventy) as there are those with an I.Q. above one hundred and thirty (very superior ability). This distribution will vary in different parts of the country. But in the national population which provides the manpower for the Army, better than two-thirds of the population can be expected to fall between ninety and one hundred and ten.

Before a comparison with the distribution of mental ability in the Army is made, it should be clearly understood that the concept of the Intelligence Quotient is not used in the Army. The Army General Classification Test is not an I.Q. test. The Intelligence Quotient is a ratio, and is expressed as follows:

$$\text{I.Q.} = \frac{\text{M.A.}}{\text{C.A.}} \times 100$$

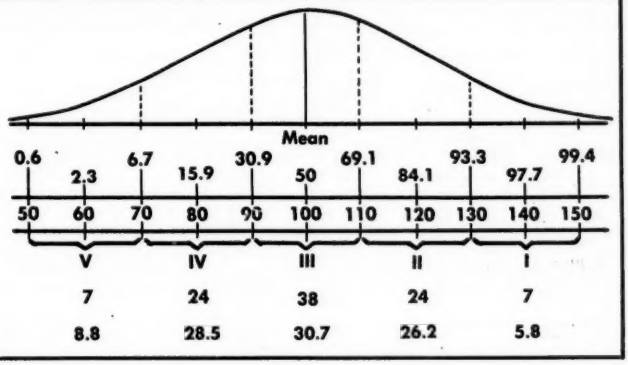
By dividing a child's mental age (as determined by an intelligence test), with his chronological age and multiplying the results by 100 (to remove the decimal point), the I.Q. is determined. Mental maturity is presumed to be reached somewhere between the ages from fourteen to twenty. The Army has no way of knowing when a soldier reached this level of mental ability; but it can determine how intelligent he is when he comes under military control. The military commander is not concerned with the rate of development of a soldier; he wants to know something about the mental ability of the man now. He is interested in what the man can learn and how fast he can learn it.

The concept of I.Q. is seldom used in ranking adults in so far as intelligence is concerned. The simplest method of ranking an adult is to consider what position he would occupy in relation to one hundred people, representatively sampled, from the national population. Such a ranking is called a percentile score. The Army has adopted a very simple procedure for ranking soldiers in terms of "standard scores." All Army test scores, with the exception of a few individual tests given at the time of induction to illiterates, are expressed in terms of a standard score in which one hundred is the midpoint and twenty points, above or below one hundred, is the stand-

ard deviation from this central tendency. About sixty-eight per cent of the Army's population may be expected to fall between eighty and one hundred and twenty; the range of scores is approximately forty to one hundred and sixty. (See Figure 1.)

An examination of the curve shown in Figure 1, in which a comparison is made of the anticipated percentage of intelligence with the actual percentage received, shows that in relation to the expected normal intelligence spread of a civilian population, the Army did not fare so badly. Considering the ten million men that came under Army control, as a whole, the picture looks fairly good, but it does not tell all the story. From the point of view of the combat arms, the distribution of mental ability, during the early months of the war (1941-1942) when the Army was in the division activation phase, as shown in Figure 2, was not in proportion to that received.

Figure 1.



The distribution of mental ability as indicated in the column under the year 1940 is approximately the same as that which might be found in a civilian population. It became successively worse as deferments grew and the more intelligent inductees were channeled off into other than the combat arms. The Department of the Army realizes that it would be inviting defeat to attempt a total war with so high a percentage of Army personnel below average or of marginal intelligence, again distributed in such proportions. The Army must take congnizance of the distribution of intelligence, aptitudes, skills, in its citizen-army, and plan accordingly. The educational program offered veterans after World War II will have a major influence in raising the general intelligence level of the national population. The importance of such an improvement is hard to overestimate.

Measurement of Mental Ability

Both prior to, and subsequent to World War I, the Army used traditional methods for the selection of its personnel. In dealing with small numbers of men, and provided there is plenty of time for observation and comparison of judgments, there is less need for the selection and assignment of personnel from a purely objective point of view. But the Army has become big business; its personnel numbered in the millions during the war and it is still a mammoth organization. The scientific selection, training and assignment of military personnel has necessarily replaced subjective procedures. Industry counts its productivity in terms of dollar profits; the Army can be considered productive when it is prepared to defend the nation.

Inefficient management, whether military or industrial, can bring failure.

The selection and training of desirable manpower for military service is a long and expensive job. The young man who enters the Military Academy at West Point, who ultimately graduates from that school and a basic and advanced school of his arm or service, has cost the government many thousands of dollars. Obviously, his initial selection must be made with care; there must be a careful evaluation of his abilities to function in the extraordinarily complex job of management in the Army.

COMPARISON OF ARMY GENERAL CLASSIFICATION TEST SCORES
(WHITE)

Grade	Score	1940	Percentage		
			September 1941—February 1942	May 1942	Division Assignment May 1942
I	130-above	7	7.60	8.0	5.2
II	110-129	24	29.20	28.3	21.3
III	90-109	38	32.67	32.2	31.1
IV	60-89	24	21.64	19.9	25.1
V	59-below	7	8.89	11.6	17.3
		100	100	100	100

Figure 2.

The soldier who is responsible for the operation, maintenance and repair of expensive radar equipment, or a complicated piece of ordnance, is a highly trained individual. The infantryman, for example, requires a good deal of ability, training and experience to operate a dozen different weapons, under the stress of combat, while maintaining an alert and resourceful attitude. Split-second decisions must be made; how well and how quickly they are made can mean life or death.

The measurement of mental ability has intrigued psychologists ever since Binet first produced his scale which measured an individual's mental age. Actually, Binet's real purpose was to distinguish the feebleminded school children from among the normal students in French schools. It was the first quantitative device that numerically evaluated mental capabilities. By the time World War I broke out, mental testing had made considerable progress, principally, however, as a clinical instrument. After World War I, the interest in tests and measurements declined in the Army due to insufficient funds for research and lack of personnel, but the Army's contribution to the science of psychology stimulated widespread research in colleges and in industry.

The Army's approach to the difficult task of measuring abilities was similar to that of researchers in the academic field. It was assumed that there was an underlying general ability, or general intelligence, which was present as a common factor in the learning process. Although many tests were available for measuring general intelligence, the Army chose to construct one which would be meaningful to military personnel and which would be applicable to adults. The Army General Classification Test which resulted contains many items involving reasoning and judgment and provides an accurate and valuable indication of general ability to learn in a wide variety of situations. In its more recent form,

it not only measures general intelligence, but also gives an indication of the soldier's mathematical and mechanical abilities.

In addition to a general ability, individuals have special abilities. The Army has taken cognizance of the presence of special abilities, more correctly considering them as aptitudes. A large number of test batteries have been prepared for measuring aptitudes in a wide variety of fields. Achievement tests, which measure an individual's present knowledge of a subject, have also been constructed covering virtually every major military occupational specialty. Research in the field of tests and measurements is a long-range project of the Army and illustrates the emphasis being placed on the scientific evaluation of the skills and abilities of its personnel.

Growth and Decline of Mental Ability

The growth of intelligence can be most accurately measured by a test. Neither by observation nor questioning can it be determined how intelligent a soldier is, or if he has reached mental maturity. On the basis of intelligence tests, its appears that the growth of the mind, like the growth of the body, is greatest in the early years. Children learn more in the years from three to seven than they do between eight and thirteen. After thirteen, the increase in intelligence is slight. This does not mean that *judgment* does not improve with age, nor that the individual cannot learn a greater variety of things. It does mean that his ability to master new subjects will not improve with age. Obviously, there will be wide individual variations among people, both as to the ages at which learning began and when the growth of intelligence ceased, or began to decline. The Army has given this problem of the decline of mental ability considerable thought. In a recent survey dealing with the problem of maximum age of commissioned officers for service with troop units, it was found through exhaustive research that on performance tests of various kinds there is a falling off of most measurable abilities in older officers. The following table shows the drop in median scores on the Army Alpha Test for officers:

Age	*Median Scores*
Less than 20	150
20 to 24	146
25 to 30	143
31 to 40	133
41 to 50	125
51 to 60	120

Despite the variation in individuals, intelligence or the capacity to learn apparently grows to maturity around twenty years of age, and then declines slightly but surely until about age fifty, after which there is a rapid decrease. Learning capacity shows a decline of approximately fifteen per cent from the age of twenty to age forty-five. The decline follows a similar curve for both individuals of superior intelligence and for those of inferior intelligence. Inevitably, there will be some compensation for this loss through the acquisition of general information, especially in men who are mentally alert; but there is no way of measuring this. Learning habits are much more difficult to break down in older men. Learning requires reorganization, and flexibility of thought suffers materially with advancing years.

There is likewise a decline in motor ability after age twenty; studies show a difference of as much as twenty per cent in men of age fifty and those twenty years old. In a combat situation, such a difference can have tragic consequences.

The age restrictions as to attendance at service schools and civilian institutions are sound, not only with a view towards educating the soldier with the longest years of service following graduation, but also because of the decrement of learning ability.

Summary

The capacity to learn, as it reflects a

soldier's ability, is a meaningful concept to the military commander. Mental tests provide the only reliable means for evaluating an individual's intelligence. The Army's test batteries are extremely reliable and valid instruments, especially adapted to military situations. In addition to the Army General Classification Test, there are scores of aptitude and achievement tests covering every major occupational skill in the Army.

Mental ability in most individuals reaches its maximum about the age of twenty. There is a slight decline in one's capacity to learn until age forty, when the decline becomes more rapid; after fifty it is quite precipitous. Naturally, there are wide individual variations; some individuals are keen in their mental reactions in spite of advanced years; but they are very few indeed. For planning purposes (i.e., education, service school attendance, special training, combat service), the average performance should be the criterion.

Standard scores are used in interpreting Army test scores; the Intelligence Quotient (I.Q.) is not used to indicate intelligence. An individual's general intelligence, or capacity to learn, as measured by the Army General Classification Test, is expressed in terms of standard scores which are divided into grades (see Figure 1), as are practically all Army tests.

Man's ability to learn, to thing clearly and quickly, to exercise judgment, and to produce creative work, continues beyond the period when physical limitations prevent him from competing with younger men; but the ravages of age begin to tell on him sooner than he likes to believe. In no other profession is this more significant than in the military, for no other profession demands so much of its personnel.

In spite of our acute need for manpower to raise and maintain a volunteer Army of one million men, we have had to raise the standards. A truly modern Army requires a higher type of soldier than ever before. The wide use of scientific material resulting from the broad program of research necessitates a superior soldier, and as always the need for competent leaders in all grades is all-important. Our Army must lead in the caliber of its men if it is to provide adequate defense in the atomic age.

Major General Leslie R. Groves

Early Development *of* Airborne Training

This article is Chapter VI of a study on the "Origins of the Army Ground Forces: General Headquarters United States Army, 1940-1942," recently published in the first volume in the series "The United States Army in World War II," and the first in the subseries "The Army Ground Forces." It was written by Dr. Kent Roberts Greenfield and Dr. Robert R. Palmer. —The Editor.

THE training and organization of airborne troops, whether parachutists or glider infantry, remained on a small scale throughout the life of GHQ. Nevertheless, during the months preceding March 1942, the foundation was being laid for the creation of one of the elements of the Army Ground Forces, a separate Airborne Command. In this development of airborne forces General Lesley J. McNair exercised an important influence and GHQ used airborne troops in maneuvers under its direction.

For some years the United States Army had experimented with the technical possibilities of parachute and air-landing forces. The German occupation of western Europe in May-June 1940 made clear the tactical possibilities of such forces, and as a result, various officers in the War Department approached the subject with renewed interest. On 5 August 1940, Major General Henry H. Arnold urged that the projected parachute units should be assigned to the Air Corps, but General McNair, as one of his first acts at GHQ insisted that parachute troops be included among the ground arms, since they used airplanes only for transport and actually fought on the ground. General McNair's recommendation prevailed. The Office of the Chief of Staff directed on 20 August that staff studies should be made of "the organization, equipment, and tactical employment of parachute and air-transported infantry."

The first American parachute unit specifically organized as such was authorized on 16 September 1940 for immediate activation at Fort Benning. It was designated the 501st Parachute Battalion, and its Table of Organization called for thirty-four officers and 412 enlisted men, all to be volunteers. GHQ played no ascertainable part in this action. The activation and training of parachute units, as of other air-landing units, remained until the dissolution of GHQ a function of the General Staff and the Chief of Infantry.

The Transport Shortage and its Effects on Organization and Training

Development of airborne units was handicapped by the severe shortage of transports. Because production of aircraft was concentrated on combat aviation little hope existed that this shortage would soon be overcome. At the end of June 1941, the United States Army possessed, except for a few planes converted from other types, only two transports in Panama, one in the Philippines, a total

of forty-nine used in Newfoundland and by the Office of the Chief of the Air Corps, two in Hawaii, and "twelve planes set up separately for parachute troops and airborne infantry training" in the 50th Transport Wing, the only such wing that had been activated. Twelve transports carried merely one company with its equipment. No more planes were expected for the 50th Transport Wing until February 1942. In 1941, the need for transport planes became so great that a request was made even for the release of the plane used by GHQ and of the four allotted to the four army headquarters for the travel necessary in conducting their extensive inspections—a request to which General McNair could not accede.

The air transport shortage naturally retarded the mobilization of new airborne units. In June 1941, when the size of the Army was approaching a million and a half, the 501st Parachute Battalion was its only airborne unit. Another, the 502d, was constituted on 1 July 1941 and the 503d and 504th in the next three months. As an administrative, nontactical headquarters for the parachute battalions, a Provisional Parachute Group was set up in the summer of 1941 under command of Lt. Col. William C. Lee. Meanwhile, the German conquest of Crete having demonstrated the value of airborne infantry, the first air-landing (as distinguished from parachute) unit of the United States Army was constituted in Panama in July 1941. This was the 550th Infantry Airborne Battalion. A company of the 501st Parachute Battalion was sent to reinforce it. In the continental United States the first air-landing unit was the 88th Infantry Airborne Battalion, constituted on 10 September 1941.

Not only mobilization but also training suffered from the shortage of transports. Only by special arrangement was the 501st Parachute Battalion able to participate in two of the eighteen air-ground tests conducted at Fort Benning, where some of the personnel of the 4th Motorized Division, who had practiced loading and unloading transports the year before, acted as air infantry. Useful lessons could be drawn from the tests, but it was felt that more thorough exploration of airborne operations was needed before plans for a full-scale development of airborne training could be made. When the commanding general of the VII Corps asked, on 6 June 1941, for one company of parachutists, he was unable to obtain it for want of the twelve planes required. It was explained that all available transports were ferrying Air Corps equipment to airplane manufacturers.

Airborne Elements in the GHQ-Directed Maneuvers, 1941

The request of GHQ to use airborne elements in the GHQ-directed fall maneuvers of 1941 encountered the same difficulty. The question of transports for these maneuvers had been discussed since March. In August the suggestion of the Army Air Forces that to conserve planes a battalion be moved one company at a time was rejected by General McNair, who replied that a battalion to be trained as a unit must be moved as a unit. Finally, on 3 September 1941, the Army Air Forces agreed to furnish thirteen transports for both the September and the November maneuvers and an additional twenty-six transports on two occasions during the November maneuvers.

In the September maneuvers of the Second vs Third Army, the only airborne unit used was one company of the 502d Parachute Battalion. Men and equipment were dropped from different planes—a practice recognized by all as bad, since men might be landed without equipment, but unavoidable until enough suitable transports could be employed. In the November maneuvers of the First Army vs IV Corps, transports were available in considerable number for the first time. An airborne

task force was organized under the Provisional Parachute Group. It consisted of the 502d Parachute Battalion and the 3d Battalion of the 9th Infantry, substituting for the as yet untrained 88th Airborne Battalion. Three missions were performed. One ended in a confused swarming of parachutists and defenders on the field. One was changed to a demonstration for reporters and photographers. The third resulted in a tactical accomplishment, the surprise capture and "destruction" of an important bridge. The chief recommendation made to GHQ in consequence of these operations was that transport planes should be assembled at home stations of parachute troops for training and rehearsal at least two weeks prior to the action intended. Unfortunately planes were still not available to carry out this proposal.

Projects for Further Development of Airborne Troops

Nevertheless, on the level of long-range planning, thought was turning to more extensive development of airborne troops. Army journals discussed the problem, and in an outstanding article, written at a time when the Army could show nothing above the battalion, Colonel Lee envisaged the formation of special airborne divisions. In July 1941, the Army Air Forces began to experiment with gliders for transportation of men and matériel. In August, G-3 of the War Department General Staff called upon the Air Forces to develop new cargo planes, explaining the testing of an airborne combat team was contemplated. This force was to consist of an infantry battalion, an antitank company, a field artillery battery, and a medical detachment. Tests were conducted by the Field Artillery in dropping the 75-mm pack howitzer by parachute. The complications arising where a new military problem had to be dealt with through the old chiefs of branches were illustrated by the organization of a parachute battery in February 1942. The Chief of Field Artillery was ordered to organize this unit, which was to receive its parachute training under the Chief of Infantry, only after confirmatory tests had been carried out by the Chief of Infantry and after the necessary howitzer had been obtained from the Chief of Ordnance.

The multiplication of airborne activities raised the question of higher echelons of command. On 11 December 1941, General Twaddle, G-3 of the War Department, submitted a memorandum to GHQ. He observed:

1. When the existing parachute battalions were set up, it was believed that parachute troops would operate in small numbers, and therefore required only an administrative, not a tactical superior headquarters. This had been provided in the "Provisional Parachute Group."

2. Subsequent experience in Europe, and in the November maneuvers, showed that in the future, parachute troops would be employed in larger number, and in connection with airborne troops, glider troops and troops on the ground.

3. The November maneuvers showed the inability of the Provisional Parachute Group to operate successfully as a tactical command.

General Twaddle therefore recommended that for the four existing parachute battalions three in the United States and one in Panama, a Parachute Group Headquarters with staff sections and a headquarters detachment be set up. General McNair concurred with reservations. He preferred a definite policy of organizing a higher headquarters for every three battalions, and he wanted the higher organization to be called a regiment.

His advice was taken in this manner. A War Department directive of 24 February 1942 constituted four parachute regiments. Each regiment was to receive as its first component, one of the four exist-

ing parachute battalions, whose numerical designation passed to the regiment. The 501st Parachute Battalion, for example, became the 1st Battalion of the 501st Parachute Infantry. No similar action was yet taken for air-landing troops, but a beginning was made in the organization of airborne troops in the usual echelons of the Army. With regiments constituted and batteries contemplated, the way was open for the creation in August 1942 of the first airborne divisions—the 82d and the 101st.

In the last days of GHQ, the airborne army existed largerly on paper, but the basic preparations had been made for its development. Control over the 501st Parachute Battalion and the 550th Airborne Infantry Battalion was not inherited by the Army Ground Forces, since both were stationed in Panama. One of the first acts of the Army Ground Forces was to create, on 23 March 1942, an Airborne Command. The headquarters of the old Provisional Parachute Group became the headquarters of the new command, and Colonel Lee the first commanding officer. The Airborne Command began its work with high enthusiasm and many projects, but with very few actual troops. Much work remained to be done before American units would be able to carry out an action similar to the German operation against Crete.

In total war, the staying power of an army, or a navy or an air force, and ultimate victory, is in its reserves and the time these reserves can be brought to bear and the manner in which their efforts are synchronized. There must always be strong, able, alert, well-organized striking forces in the regular establishments. But because the regular forces would be going into action so fast and on such a world-wide scale, it is more important than ever that we have adequate reserves ready to back them up. Such a regular force must be freed for action; not cadred to death or sacrificed for want of support.

* * *

Within five years the pattern of war has changed radically. Its velocity has multiplied many fold. It extends to the ends of the earth.

Lieutenant General Raymond S. McLain

Artillery Support *in the* Capture of Hill 192

Lieutenant Colonel Donald C. Little, *Field Artillery*

The following article is one of a selected number of monographs, prepared by officers attending the 1946-1947 class of the Command and General Staff College, which will appear in the MILITARY REVIEW from time to time.—The Editor.

Introduction

A rolling barrage is a series of artillery fires delivered on successive lines on a fixed time schedule. During World War I, the rolling barrage was the normal method of artillery fire in an attack. Experience indicated that such a barrage was both wasteful of ammunition and ineffective, since we had no positive means of coordinating its advances exactly with that of the infantry. Yet in the assault of Hill 192 in Normandy, a rolling barrage was used to good effect by the artillery which supported the 2d Infantry Division.

The forward observer system adopted by our field artillery between World Wars I and II enabled our artillery to fire on areas of enemy resistance successively as our infantry advanced in an attack. Why then was a rolling barrage fired during the attack on Hill 192 in July 1944?

The Situation (Figure 1)

Hill 192 is a commanding height situated three miles east of St. Lô, France. On 7 June 1944 (D+1 of the Normandy landings), the 2d Infantry Division had landed on Omaha Beach, passed through elements of the 1st and 29th Infantry Divisions which held the beachhead, and fought thirty kilometers south to Hill 192. There, because of stiffening German resistance and lack of logistical support, the Division had halted on 17 June.

For over three weeks the division sat on the northern slopes of Hill 192 and on a line six kilometers east of it, while supplies and reinforcements were brought into the beachhead. Then, on 11 July, the division was ordered to capture Hill 192 and the St. Lô-Bayeux road one-half mile to the south, as a preliminary to the general St. Lô breakthrough to take place two weeks later.

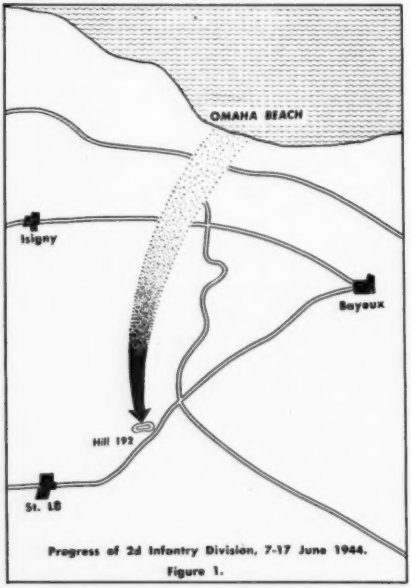
The Terrain

Hill 192 was not a peak, but was a long, sugar-loaf hill some fifty meters higher than the surrounding ground. The Germans had built a tower in the trees on its summit, and from this tower, on a clear day, one could see the shipping off Omaha Beach, twenty-odd miles to the north. We thought that when we had taken Hill 192, we could use it for our own observation against the Germans, but we were disappointed to find the ground to the south was even higher, and while Hill 192 was a fine OP looking north, it was no good looking south.

This was the hedgerow country of Normandy. Hill 192 and the entire zone of the 2d Infantry Division was a patchwork of hedgerows. The hedgerows surrounded fields and lined sunken roads. The fields

were of various sizes and shapes. About a third of the fields were orchards, the rest were under cultivation. Small groups of farm buildings dotted the area.

The hedgerows themselves were formidable obstacles. They varied from four to eight feet in height and from three to eight feet in thickness. They were built of closely packed earth and rock and were



Progress of 2d Infantry Division, 7-17 June 1944.
Figure 1.

usually sodded and topped with hedge whose roots further strengthened the wall.

As is now well known, each field in this area was a battleground in itself. Each hedgerow was obstacle and observation combined, and limited the field of fire to the next hedgerow only. On Hill 192, however, the Germans had excellent observation not only of the zone of the 2d Infantry Division, but of the 29th and 1st on the west and east, respectively. From Hill 192, artillery could be and was directed over the entire area of V Corps, and roving guns fired from any number of firing positions.

It was this dominating Hill, interlaced throughout its length and height by formidable hedgerows, that the 38th Infantry of the 2d Infantry Division was to capture on 11 July 1944.

The Enemy

Of more importance than the terrain was the enemy that defended Hill 192. In the first days of the fighting south of Omaha Beach, the enemy had been for the most part members of the static coast defenses, including Russians. As Hill 192 was approached, however, a new brand of opposition developed. These new

A typical sunken road of Normandy.

defenders all wore mottled camouflage suits and all seemed to be armed with automatic weapons. They were soon identified as members of the 9th Parachute Regiment, 3d Parachute Division, who had been rushed from Brittany to halt this American penetration of the Normandy defenses.

They were clever, tenacious foes. They fired their "Burp" guns from trees, hedgerow corners, and buildings. During the period from 17 June to 11 July, while the Americans awaited the order to resume the attack, the paratroopers converted each hedgerow on the northern slope of Hill 192 into a maze of dugouts and firing positions. Tunnels were dug through the base of each hedgerow to afford apertures. Firing pits dug along the tops of the

hedgerows were zigzagged for greater protection.

Machine guns as well as towed and self-propelled antitank guns fired from prepared positions throughout the defended area. Movement laterally and to the front was covered by the hedgerows themselves and the many orchards and tree-lined trails throughout. Mortars were emplaced in countless positions covering every American position and avenue of approach.

The Germans' greatest asset was the caliber of the troops themselves. They were always in the next hedgerow. Our patrols sent out at night were shot up badly or gobbled up entirely. If we withdrew a hedgerow or two to bring down fire on their positions, they followed us back and were there again—in the next hedgerow. I watched as a group of paratroopers was being questioned after the hill had been captured. One ragged, bearded survivor expressed the spirit of the 3d Parachute Division when he was asked what he thought of the Americans now. Looking fixedly at his questioner he answered without hesitation: "Germany will win!"

The Plan of Attack (Figure 2)

When the order came from V Corps to capture Hill 192, the 38th Infantry held the right third of the 2d Infantry Division sector, with Hill 192 to its front. On the right of the 38th Infantry was the 116th Infantry of the 29th Infantry Division. On its left was the 23d Infantry of the 2d.

With its three regiments already on

Looking north from Hill 192.

an extended front, the division ordered the 38th Infantry to capture Hill 192, the 23d to capture the St. Lô-Bayeux road in its zone, and the division and supporting corps artillery to weight the effort of the 38th Infantry. The 29th Infantry Division would attack simultaneously to capture high ground to the west.

The 38th Infantry decided to attack with the 1st and 2d Battalions abreast, the 2d on the right, to capture the objectives shown on Figure 2. In the zone of the 2d Battalion lay the main roads and trails being used by the enemy, the farm villages of Cloville and Le Soulaire, and the small patch of woods on the summit of Hill 192. The 1st Battalion zone included the more exposed eastern half of the hill and a very large patch of thick woods on the reverse slope of the hill.

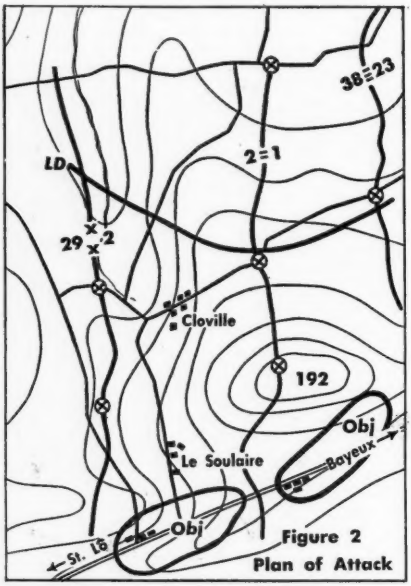
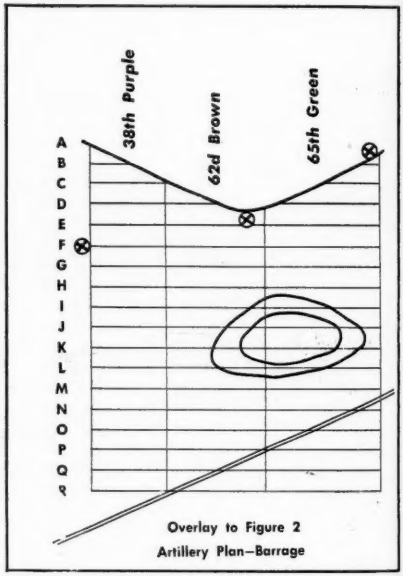


Figure 2
Plan of Attack

Because of the hedgerows, the opposing front lines were in some cases less than 100 yards apart. Each hedgerow line might be the main line of resistance. Therefore, in order to bring maximum fire of artillery and mortars on the nearest enemy hedgerow, our line of departure for the attack would be two hedgerows (about 200 yards) back of our present front line. Withdrawal to the line of departure would take place during the first part of the artillery preparation. H-hour for the attack was 0600 hours (about first light) 11 July.



Overlay to Figure 2
Artillery Plan—Barrage

The Artillery Plan

To support this attack the division artillery was reinforced by the 62d and 65th Armored Field Artillery Battalions of the V Corps Artillery, and two battalions of heavy corps artillery.

The 38th Field Artillery Battalion, in direct support of the 39th Infantry, was given the 62d and 65th Armored Field Artillery Battalions to reinforce its fires.

The artillery fire plan consisted of two

main parts: (1) the preparation which would last for one hour and (2) the supporting fires during the attack, consisting of a rolling barrage for the light battalions, and deepening and thickening fires of the medium and heavy battalions.

During the first fifty minutes of the preparation the light battalions fired on located machine gun and mortar positions in the enemy forward areas, while medium and heavies went for enemy batteries, command posts, and reserve areas. In the last ten minutes of the preparation the lights and mediums came down on the first enemy-held hedgerow, the mediums firing on impact, and the lights with time fire, the fragments reaching into the Germans' holes and emplacements. Fires of the infantry heavy weapons were integrated with the artillery preparation.

Then was to begin the second phase, or rolling barrage (Overlay to Figure 2). It was estimated that the infantry might advance at the rate of 100 yards every four minutes, and therefore every four minutes the artillery in the barrage would raise the range 100 yards, fire one volley, and maintain a slow fire of one round per gun per minute until at the end of the four minute period the process was repeated. In order to keep the fire plan flexible and conforming to the actual advance of the infantry, the 100 yard fire lines were superimposed on the 1:5000 yard battle map being used by the infantry and forward observers. Each range line was lettered, and the fire lines of each artillery battalion were named as a group by colors, so that a forward observer could report "Hold Brown on Jig, advance Green to King." Fifty yard advances of the barrage were obtained by calling for "King plus 50."

Preparation for the Attack

Because of the nature of the terrain, the closest cooperation was necessary between infantry, tanks, engineers, and artillery. Tank platoons of the battalion attached to the division were attached to each assault infantry company, and intensive tank-infantry assault training was conducted in division rear areas for two weeks prior to the attack. Tanks were not all equipped at this time with the cutting teeth that were used entirely in the St Lô breakthrough two weeks later, and it was necessary for demolition teams to precede tanks and blast holes through the hedgerows for them. It was a squad and a tank to a field, the squad to advance

A typical hedgerow machine-gun position.

to the next hedgerow while covered by the fire of the tank, then the tank advanced while covered by the squad.

The artillery in direct support of the 38th Infantry (see Figure 3) was organized as follows:

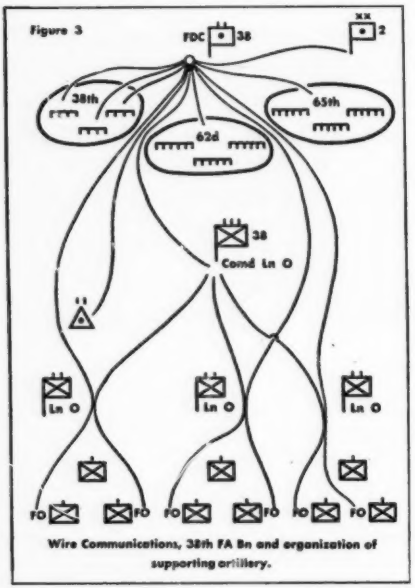
a. Fire direction center of the 38th Field Artillery Battalion controlled all fires, acted on request of forward observers, and made necessary changes in scheduled fires.

b. A forward command post was established by the 38th Infantry in a sunken road about a thousand yards back of the line of departure. At this forward command post complete communications were established, including lines from the artillery liaison officers to the artillery battalion commander. Here the progress of each company was studied and the fire

plan supplemented or revised as necessary.

c. It can be seen from Figure 3 that each artillery liaison officer was on a party hookup with the forward observers with the assault rifle companies, the fire direction center, and the artillery battalion commander. Radio of course was the alternate means of communication.

d. Observation furnished by forward observers was supplemented by a sixty



Wire Communications, 38th FA Bn and organization of supporting artillery.

foot tower observation post erected in the trees 500 yards in rear of the front lines, and affording excellent observation of the hill. Liaison planes furnished overall surveillance of the battle area, and looked especially for enemy batteries.

e. The forward observers of the 38th Field Artillery Battalion who operated normally with the assault companies of the 38th Infantry would control the barrage fires of the three artillery battalions firing in front of the infantry. The 62d and 65th had forward observers out to report any initial errors direct to their own fire direction centers, but the fire direction center of the 38th gave the targets, time schedules and commands to fire to the 62d and 65th.

f. On the two days prior to 11 July, the eight battalions of division and corps artillery that were to support the attack, registered on map located points on the hill. Every lot of ammunition that was to be used was registered. This assured direct hits on located gun emplacements during the preparation. Aerial photos and patrols had uncovered many of these exact locations.

The Attack

At 0600, 11 July, following the artillery preparation, the infantry jumped off, and following the rolling barrage, by late afternoon had captured its objectives. Enemy resistance was continuous and stubborn throughout the day, for although gun emplacements and hedgerows had taken direct hits from artillery fire, the enemy was so well dug in that many had to be killed at close quarters. Captured German officers were curious about the American "automatic" artillery.

Counterattacks by the enemy to retake the hill were expected, and defensive fires were already prepared on call, and forward observers adjusted on check points as soon as the hill was taken in order to mass all fires. The counterattacks did not develop.

The 38th Infantry had taken fairly heavy casualties, but they were less than had been anticipated for the reduction of this heavily defended area. Less than 200 prisoners were taken, but the enemy dead were many times the number of prisoners. Many German dead, killed by time fire and bursts on the top of hedgerows, had to be dug out of holes and hedgerow emplacements.

An unmailed letter taken off a dead German two weeks later described the

shelling of Hill 192 to a friend back in Germany: "At 1135 I left the platoon sector as last man. Carried my machine gun through the enemy lines into a slightly more protected defile and crept back again with another fellow to get the wounded. . . . On our way back we were covered again with terrific artillery fire. We were just lying in an open area. Every moment I expected deadly shrapnel. At that moment I lost my nerve. The others acted just like me. When one hears for hours the whining, whistling, and bursting of shells and the moaning and groaning of the wounded, one does not feel to well-. . . . Our company had only thirty men left (out of 170)."

Conclusions

More than 25,000 rounds were fired by the eight artillery battalions in this attack, an average of 300 rounds per piece for the 105s. Except for three days during the Battle of the Bulge, this was the heaviest expenditure of ammunition in the experience of the 38th Field Artillery Battalion.

This was the only rolling barrage fired by the 2d Infantry Division Artillery in eleven months of combat, but nowhere again did the situation require its use.

Lessons Learned

(1) Unusual situations sometimes require unusual methods.

(2) Shells are less expensive than men's lives.

(3) In every operation careful prior planning saves lives and assures accomplishment of the mission whatever the enemy reaction may be.

It is easy for wars to become idealized as they recede in the past. The tendency then is to forget the mistakes, the defeats, the individual failures of officers or men—and to remember the victories and overstate the accomplishments. A supreme compliment to World War II is that we do not need the dim perspective of history to realize what our Army did. Despite the cries of critics, just and unjust, we know today that our military forces were the determining factor in the greatest victory of all time in a war which dwarfed in size any war of the past.

Secretary of the Army Kenneth C. Royall

Soil Trafficability

Lieutenant Colonel Robert R. Glass, *Infantry*
Instructor, Command and General Staff College

"INTERMITTENT rain and snow had made a quagmire of the countryside. Heavy vehicles bogged down as shoulders gave way along the narrow route. Movement was reduced to a walking pace." (Extract from After Action Report of an armored division, 7-8 March 1945.)

"An extremely bad road net and unfavorable terrain for cross-country operations impeded the progress of CCB." (Extract from After Action Report of an armored division, 30 March 1945.)

"It being impossible to maneuver on the soggy terrain, Task Force _____ launched a dismounted infantry attack." (Extract from After Action Report of an armored division, 30 April 1945.)

"The attack of the _____ Armored Division has been slowed down due to the difficulties of the terrain." (Extract from countless communiques during World War II.)

Introduction

Although the farmer, and the greenkeeper of the golf course, hope for reasonably frequent rains, the soldier in battle rarely, if ever, shares their feelings. To him, the arrival of a rainstorm generally means at least two things, other than personal discomfort: airplanes cannot fly, and tanks cannot move. This is a rather extreme conclusion to draw as a result of the wet weather, and one which warrants a closer examination. Airplanes can fly, and have flown, in wet weather; and some tanks have moved across a soggy field while the tanks in a field one hundred yards away have bogged down.

With the advent of heavier tanks and heavier wheeled vehicles in the armored divisions, and with the addition of tanks to the infantry divisions it becomes of increasing importance that all commanders know where and when tanks may operate successfully across country and on unpaved roads. The two factors which determine this are the weather and the soil trafficability. Soil trafficability means the ability of a soil to support military traffic. If the weather is clear and dry, the trafficability of most soils is very nearly alike. When it rains, however, various types of soils react in different ways. Some become quagmires—virtually impassable to a tank built along current patterns; other soils, adjacent to the quagmire, may provide reasonably good going.

Determination of Soil Trafficability

All soil is not the same, as well we know. There are many combinations of gravel, sand, silt, and clay that constitute the physical structure of the surface soil. And there are an equal number of combinations of the structure of the sub-surface which provides the drainage for the surface soil. A coarse-textured surface soil that is well drained will certainly be more trafficable after a rain than a fine-textured soil, no matter how well or poorly drained. The poorly drained

clays and silts become the quagmires, whereas the adjacent area of coarse-textured soil will permit a heavy tank to travel with relative ease. Obviously, the problem is to determine the location of the areas of clay and the areas of coarser soil. The answer cannot be obtained from the conventional topographic map.

The ability of the soil of a certain area to support the movement of heavy military traffic is based on a combination of four factors: the physical properties of the surface soil, the structure and drainage characteristics of the sub-surface soil, the drainage characteristics of the area as determined by its relief and existing vegetation, and lastly, of course, the weather itself.

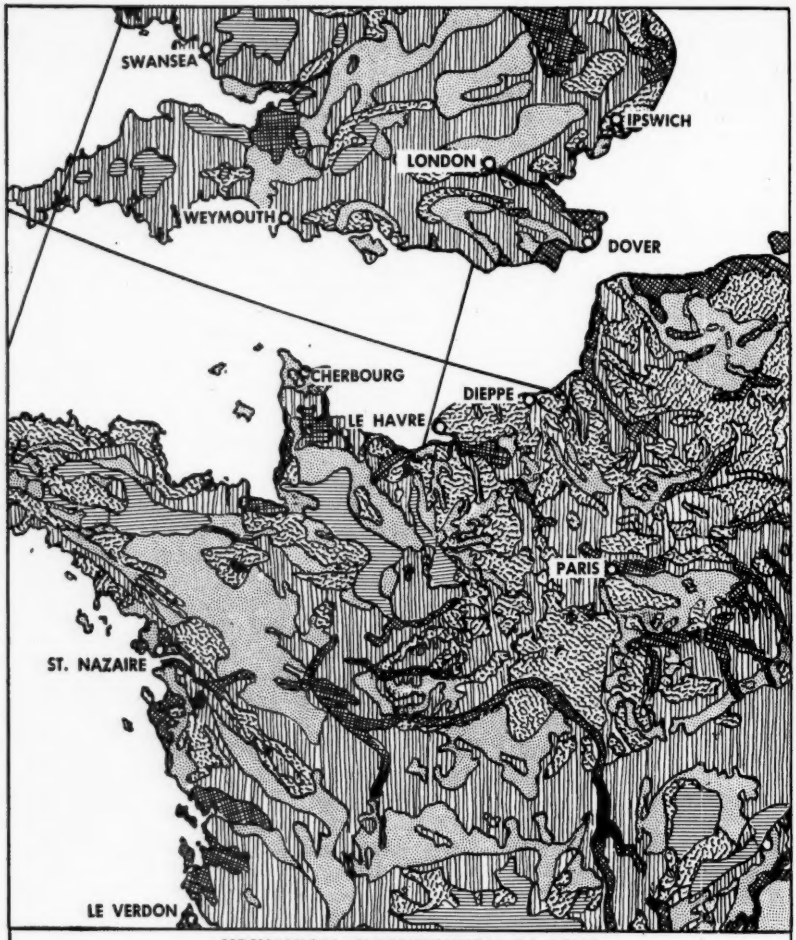
The physical properties of the surface soil are determined by the manner in which it was formed. Generally speaking, "soil" is formed from the weathered rocks of the earth as a result of three processes: leaching, or solution by chemical action of soluble minerals in the mantle; eluvial action, or removal by suspension of the finer insoluble particles in the mantle, and the collection of humus or decaying organic matter. Thus, over areas of varying sizes and shapes, the soil is made up of varying percentages of what we commonly refer to as gravel, sand, silt, clay, and humus. The exact percentage of these different sized particles will in part determine whether a heavy rain will drain through or run off the surface soil.

It is not enough that we know the physical structure of the surface soil; for the structure of the sub-soil will also have a bearing on the ultimate trafficability of the area. Below the mantle of surface soil is a zone of sub-soil varying in thickness from a few inches to several feet. The ability of the sub-soil to carry away the moisture that drains through the surface soil will determine to some extent whether or not the surface soil becomes water logged during prolonged precipitation. If the layer of sub-soil is thin, and the parent rock below it is close to the surface, the drainage characteristics are not likely to be good. On the other hand, if a thick belt of coarse and loosely amalgamated sub-soil exists, any moisture that seeps through the surface soil will probably be carried away through underground "rivers," and minimize any chance that the surface soil will become water logged, creating a bog.

Nor is the soil trafficability determined solely by an analysis of the two preceding factors. The relief of the area and the type of vegetation existing on the surface soil will also exert an influence on the ability of the area to drain itself promptly during a rainstorm. Obviously, sloping ground will permit water to run off more readily into lower areas, whereas a flat area, or a valley, must absorb the greater part of the moisture it receives. The nature of the vegetation will affect the run-off of the soil and also the ability of the soil to support a load, irrespective of the physical properties of the surface soil and sub-soil. A grassy area, on a slope, will slow down the run off and permit greater absorption of moisture than will a bare slope. A forest area or woods, partly because of the accumulation of humus from decaying leaves and other organic matter, will also slow the run-off of water on a slope. Furthermore, the root structures of both grasses and forests assist in the drainage of the surface soil and knit it together into a load-distributing mat which materially affects the trafficability of the area—so much so, that in forests are generally found the most trafficable of all soils.

Influence of Weather

So far we have concerned ourselves primarily with the subjective factors relating to soil trafficability, that is, the nature of the surface soil, the sub-soil, the relief, and the vegetation. These are relatively fixed, within our lifetime, in any given area. However, the one phenomenon



MECHANICAL CLASSIFICATION OF SOILS

COARSE-TEXTURED SOILS.
(Trafficable Except During Heavy Precipitation.)

MEDIUM-TEXTURED SOILS.
(Trafficable Except During and Immediately After Heavy Precipation.)

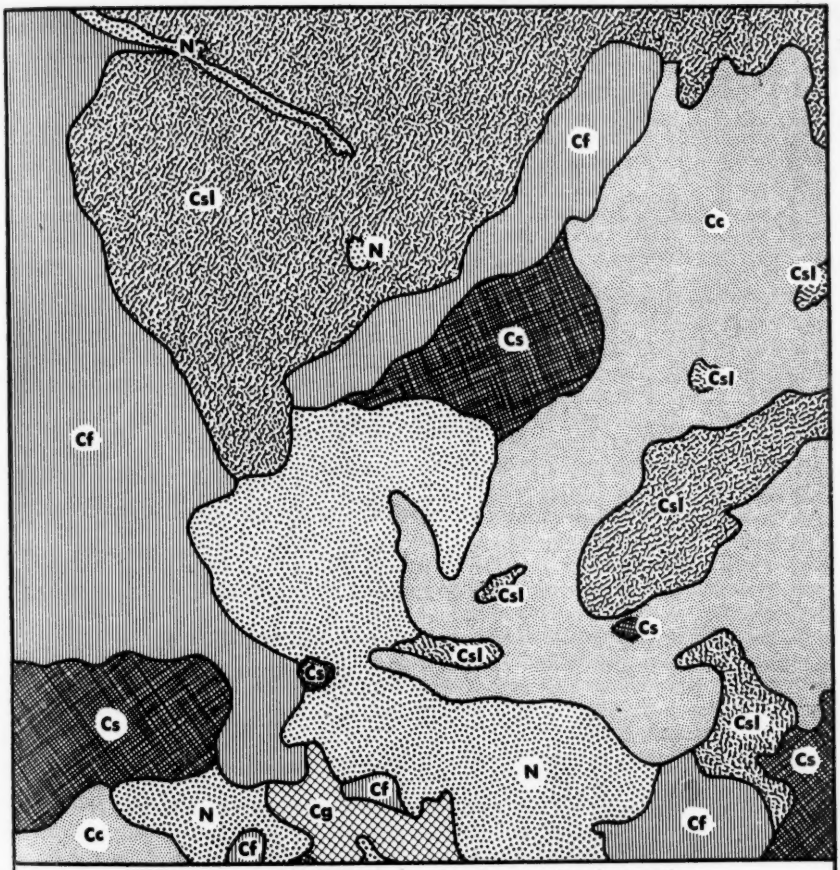
FINE-TEXTURED SOILS.
(Non-Trafficable Except During Dry Weather.)

ALLUVIUM, TUNDRA, SWAMP, AND COASTAL MARSH LAND.
(Non-Trafficable Except When Frozen.)

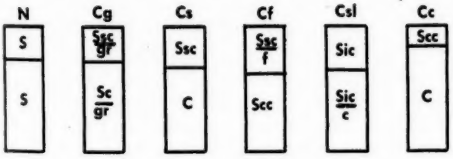
MOUNTAIN LAND OR EXPOSED ROCK.
(Generally Impassable Except over Established Roads.)

LAKES

Figure 1.



Extract of a Soil Map, Lancaster County, South Carolina.



SOIL PROFILE (Three feet deep)

Legend:

- S Sand
- Ssc/gr Sandy loam and gravel
- Sc/gr Loam and gravel
- Ssc Sandy loam
- C Clay
- Ssc/f Fine sandy loam
- Scc Clay loam
- Sic Silt loam
- Sic/c Silt and Clay

Figure 2.

which has the power to affect these characteristics, and the resultant trafficability, is the weather. Weather affects trafficability in two ways; either through precipitation, or through extreme changes in temperature. A long steady drizzle, a flash storm, or a light shower will test the ability of the area to withstand varying degrees of moisture. Some areas, with a hard surface or a steep slope, will force the water to run off through eroded gullies into a more absorbent zone; other areas, readily absorbent and with little slope, will permit the water to soak through and drain away through underground rivers; while a third area, with an impervious sub-soil, will cause the surface soil to become water logged and turn into a quagmire. These three areas may well be side by side and, on casual observation, appear much alike. It is only by a careful analysis of the soil and sub-soil that we can determine in advance which of the three areas to use as an avenue under adverse weather conditions.

The second condition of weather, the freezing or the thawing of the ground, is a subject in itself and will not be treated fully. It is sufficient to say, for the present, that a bog or swamp may become perfectly trafficable when frozen, and that the frozen tundra of the arctic may become a bog during a thaw.

It is therefore apparent that if we are to determine whether or not an area under consideration will be trafficable, we must take into account the weather forecast as well as the weather conditions that have immediately preceded our planned operation. The source of the information is a weather detachment of the Air Weather Service, U.S. Air Force.

In our Army, during the past war, soil conditions were determined, analyzed, and predicted by at least three different agencies. These were the Strategic Intelligence Branch of the Corps of Engineers, the Military Geology Unit of the Department of the Interior, and the Air Weather Service of the U.S. Air Force. Each of these—and the product of their endeavors—served a particular field; but, among them, the one with which we are most profitably concerned is the Air Weather Service. Because of the obviously close relationship of weather conditions to the physical characteristics of the soil in determining its trafficability, the Air Weather Service, and its detachments in the field operating with armies and corps, is responsible for the preparation and dissemination of soil trafficability information. This information is prepared and distributed in the form of maps of an area charting the mechanical classification of the soil, or in the form of special studies of an area in the vicinity of a city of strategic significance. All too often the maps have been of a scale too small to be of any appreciable value in limited objective operations; nevertheless, it is of growing importance that even this general information be related to plans, and that, in the future, maps of soil trafficability of a sufficiently large scale be made available to commanders of all units.

The Air Weather Service recognizes four broad textural classifications of surface soil: sand, coarse-textural soil (or silty sand), medium textural soil (or sandy clay), and fine-textural soil (or clay). These classifications generally suffice for strategic planning; however, from a tactical standpoint it is frequently necessary, and entirely possible, to elaborate on these four classifications and arrive at a more precise picture of the soil conditions and predicted trafficability. Many maps depicting the mechanical classification of soils, which are available for areas of the theaters of the last war, describe the terrain in terms of alluvium, desert soils, dry forest soils, and exposed rock and mountainous soil, in addition to the four basic classifications recognized by the Air Weather Service. This further classification permits a more detailed study of the area in terms of its trafficability. Figure

1 illustrates a typical trafficability map as prepared by the Air Weather Service.

A soil trafficability map, as prepared by the detachment of the Air Weather Service operating with corps headquarters may be effectively colored to indicate trafficability. If green is used to indicate areas which are entirely trafficable, if red is used to indicate those areas which are non-trafficable, orange and yellow-green can be used for those areas whose trafficability ranges from poor to good. A glance at such a map will show readily those avenues or zones in which the employment of armor will be most feasible. The green "paths" stand out as clearly and as significantly as the roads on a road map.

Peace-time training, however, does not always make it possible for the unit commander to request a soil trafficability map from the nearest weather detachment. The training of the weather detachments frequently does not permit them, with their resources, to fulfill this war-time function. In this case, the intelligence officer himself can frequently accomplish the work of the Air Weather Service, at least partially. Soil surveys for much of the area of the United States have been prepared by the Department of Agriculture. These surveys normally cover a particular county, but occasionally an entire state is studied as a whole. The surveys include a large scale map depicting the types of surface soils, together with textual material describing the sub-surface drainage characteristics. The scale of these surveys is ideal for division operations, and from them the intelligence officer can, with a little study, prepare an adequate and reasonably accurate soil trafficability map. Figure 2 illustrates a portion of a soil map as prepared by the Department of Agriculture.

Application of Trafficability Information

General Lopez Valencia in an article in *Ejército* (Spain) summarizes as follows: "Experience teaches us that a war vehicle cannot yet be built that we can say operates in all kinds of terrain. . . . In the war of the future, the terrain will achieve an importance even greater than now. The best defense against tanks will be provided by the terrain."* Nor is this reaction toward the trafficability of the terrain an entirely new one. Major General J. F. C. Fuller (British Army, retired) wrote in 1928: "Today, land strategy is almost entirely woven on roads and railways, but cross-country machines, though they will not abolish roads and railways, will give to strategy another dimension. . . . for example, ground (on maps) will have to be colored to show where tanks and roadless vehicles can move at ease, can move with difficulty, and cannot move at all, so that at a glance a commander is able to see from his map how best to deploy his mechanized arms."

The validity of General Fuller's premise was at least in part born out by experiences in World War II, in which armored units operating on an extended front under critical conditions of weather found portions of their vehicles bogging down while others nearby moved with relative ease. Whether or not the information on which to base a soil trafficability map was available, in the past, to all commands is frequently difficult to determine. Whether or not, if it was available, it was colored (as Fuller suggests) or otherwise used, is equally difficult to discover. While it is recognized that "strategic necessities may prevent the choice for military operations of the locality that is most desirable with reference to the trafficability of the soil," this possibility emphasizes the importance of knowing and understanding the conditions that do exist in order that pre-planned measures may be taken to overcome the expected difficulties.

It is one of the responsibilities of the

* "Evolution of Future Warfare," MILITARY REVIEW, Vol XXVII, No. 1, April 1947.

intelligence officer to provide his commander and the troops with an interpretation of all of the characteristics of the area of operations. One of these characteristics is termed terrain. A terrain estimate is incomplete unless it includes information concerning soil trafficability whenever the off-road employment of tanks and heavy, wheeled vehicles is contemplated. The manner in which soil trafficability information is presented to the commander or disseminated to the troops is a test of the ingenuity of the intelligence officer. It goes without saying that if the information can be presented in a readily understandable way, it will gain wider and more efficient use. A picture of some sort is certainly indicated. A few words in a written estimate, such as "the soil in the area of operations is generally sandy with scattered bogs" will not indicate to a commander or to his troops what to do about it. A map, however, showing the exact location and extent of the bogs, as well as of the sandy areas, or areas of any other type soil, interpreted in the light of the existing and predicted weather conditions, will tell a commander where his tanks will have the most success from the standpoint of the "going." On the basis of just such detailed information as this, the tanks of a unit may very appropriately choose a longer route to an objective in order to make certain of getting there.

All United States military doctrine is based upon reliance on the ingenuity of the individual working on his own initiative as a member of a team and using the most modern weapons and equipment which can be provided him. The individual makes a modern army, not the mass.

Lieutenant General M. S. Eddy

Recovery of Allied Military Personnel in the ETO

Lieutenant Colonel Charles J. Hackett, *Coast Artillery Corps*
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Plans

COINCIDENT with the planning for the invasion of the continent of Europe, planning was initiated for the recovery of Allied military personnel who were held as prisoners of war by the Germans. The initial steps in this planning were undertaken by the PWX (Prisoner of War Exchange) Branch, G-1 Division, Supreme Headquarters Allied Expeditionary Forces.

It was realized from the beginning that the physical condition of the prisoners might well be such that considerable medical facilities would be required and, further, that this requirement might be greater than existing facilities in the combat area. This factor, together with the desire to get all prisoners repatriated as soon as possible after recovery, influenced all planning before and during Operation "Overlord," and was in the minds of those individuals at all levels of command who took part in the actual operations dealing with the recovery program.

During the late summer of 1944, the PWX Branch, Supreme Headquarters, started a course of instruction in handling recovered prisoners of war. The students, who were British and United States army officers, were given extensive instruction in the procedures to be followed in processing Allied prisoners of war from the time of recovery until arrival in the communications zone. It was contemplated that these officers would serve as "PWX contact officers" and as the nuclei for "PWX detachments."

The PWX contact officers were to be attached to army groups by Supreme Headquarters for the purpose of assisting in the operation and administration of prisoners of war camps. It was felt that officers specially trained in procedures for handling recovered prisoners of war could be of considerable assistance to field force commanders, who would undoubtedly be required to care for the recovered prisoners in addition to carrying on normal tactical operations. Each contact officer was to have an enlisted assistant, who would serve as clerk and driver. United States and British Navy, Air Force, and Merchant Marine personnel were available for advice and assistance to the contact officers in the evacuation of prisoners who were members of those respective services. Contact officers of other United Nations were available to accompany United States and British contact officers and were responsible to them for their own nationals. They were responsible to their respective governments, however, in regard to documentation, pay, accounting, etc. Each contact officer was furnished one jeep.

PWX detachments were made up of mixed United States and British officers and enlisted personnel, and like the contact officers, were also to be attached to army groups. There were equal numbers of United States and British officers in each detachment. In those detachments where a United States officer was senior, the second in command was British, and in those in which a British officer was senior.

the second in command was a United States officer. It was expected that those detachments having United States officers in command would be attached to Sixth and Twelfth Army Groups (U.S.) and that those having British officers in command would be attached to Twenty-first Army Group (Br). The principal duty of the detachments was to assist field force commanders in the recovery of Allied military personnel and, as in the case of United States and British contact officers, officers of the various services of other Allied Nations were available to assist in processing individuals of various nationalities.

The instrument of surrender called for the German government to provide food and medical facilities to all Allied prisoners in German hands. This provision, of course, was based on the assumption that some type of organized government would be in existence in Germany at the close of hostilities. Regardless of what would be found in Germany however, army group commanders were specifically charged with the responsibility for the safety, recovery, care, maintenance, administration, and evacuation of all Allied prisoners of war uncovered or arriving in their respective zones of operation. The communications zone commander was given the responsibility for the care and subsequent handling of such prisoners as might be turned over to him by army groups. Thus, so far as the United States was concerned, the division of responsibility was quite clear—army groups were to take care of all recovered personnel as long as they remained in the combat area, while the communications zone would accomplish all necessary matters after the arrival of the recovered personnel in the communications zone. This was to include staging for shipment to the United States of all U.S. personnel.

As of 1 March 1945, the estimated number of prisoners held in the proposed AEF sector of Germany was 1,215,073, of which 496,684 were Russian; 133,389 U.S. and British, and 585,000 belonged to other Allied nations.

Efforts were made by Supreme Headquarters to ascertain and point out to army group commanders the locations of the various prisoner of war camps in Germany so that elements of the field forces could make necessary plans for the handling and evacuation of personnel in camps in their respective zones of advance. The fact was stressed however, that the information secured was not too accurate, and that as the Allied armies advanced from the east and from the west, the movement of prisoners would become more frequent, and the congestion in the center of Germany would become more pronounced. It was to be expected, therefore, that the conditions under which prisoners were held would deteriorate, with consequent serious effects on the health of the prisoners.

The Supreme Commander accepted the responsibility for distributing orders to all Allied prisoners to remain in place upon cessation of hostilities or upon being overrun by Allied forces. These instructions were to be dropped in leaflet form and broadcast on such wave lengths as would insure easy reception in every part of Germany. The object of the "Stay Put" order was to facilitate and expedite the evacuation of recovered personnel from the combat zone. It was believed that personnel could be evacuated under the organized recovery program much faster and with less inconvenience to themselves and to the field forces than if they were to attempt to make their way to the rear individually.

Operations

The first experience in which units of Twelfth Army Group encountered a prison camp occurred during the first week of December 1944, when units of the Third Army overran two camps on the French-

German border. In these camps, there were approximately 2,100 prisoners of war of eastern European nationality. This experience served as a preview to the large-scale recovery program which was to follow and served to provide an insight into the problems which were to follow. At the time of this overrunning, there were four PWX contact officers in Twelfth Army Group area and all were attached to Third Army. After these individuals had gone through this initial experience they were requested to write detailed accounts of the problems encountered, and these reports, together with army reports, were the subject of considerable study by Twelfth Army Group and Supreme Headquarters. It was found, for example, that the first requirement of the recovered prisoners was a thorough delousing—not food as was generally assumed. Another discovery was that the prisoners had been on such a starvation diet that the C ration was too rich for their systems and they could not retain it. The planners' assumption that considerable medical attention would be required was borne out in every detail, and it was found that blankets and clothing would have to be provided any prisoners who were overrun during the winter months.

Twelfth Army Group instructed the armies (First, Third, Ninth, and Fifteenth) that every effort would be made to provide such PWX contact officers, PWX detachments, and Allied contact officers *as might be requested by the armies*, but that none of this type of personnel would be sent forward unless it was specifically requested. In other words, the various army commanders were charged with complete responsibility within their areas and army group would not attach unwanted personnel. By late winter of 1944-1945 requests for the attachment of contact officers and detachments in limited numbers were forwarded by armies to army group and from army group to Supreme Headquarters. Later in the spring of 1945, armies were forced to request that all available contact personnel be sent forward to assist in handling the large numbers of prisoners overrun. Until army requisitions began to approach the total of contact personnel available, no difficulties were experienced and an army could expect to receive the personnel requisitioned within three or four days after the requisition was submitted. Practically all requisitions were handled by telephone and confirmed in writing. In at least one instance of an emergency nature, two complete detachments, except for transportation and drivers, were flown direct from England to an army headquarters. The drivers proceeded by boat and overland with the transportation.

During the first week of April 1945, complete plans were issued by Supreme Headquarters outlining the procedures which would apply for evacuating recovered personnel to the communications zone and to England by air. It was stated that air lift was to be considered as supplementing other forms of transportation, but when it was found that evacuation from Germany to Paris by rail would take a minimum of three days, at least half of which would be by freight cars, it was resolved to use air as much as possible and not consider it as being supplementary to rail.

The First U.S. Army initiated the full-scale recovery program by overrunning large numbers of prisoners the first week of April. At this time the program was under the direction of G-1 at all levels of command, and with the exception of one army, members of the various G-1 sections performed a great deal of the actual operations throughout the program. The reason for the general staff operating in this case was that all the planning had been done by the various G-1 sections and the plans were based upon many assumptions which might prove to be incorrect. In this event, constant changes

in plans would have to be made while the operation was in progress and this fact, together with the fact that the operation was expected to be of short duration, indicated that G-1 operation would be more economical of manpower and would provide better continuity of policy. The one army which did not follow this plan turned the operation of the program over to the army provost marshal. In this case, however, it was necessary to augment the provost marshal's section by the establishment of a Prisoner of War Executive Subsection, the members of which were in addition to the normal complement of the provost marshal's section.

During the initial stages of full-scale operation the armies telephoned G-1 Twelfth Army Group every evening giving the number and nationalities of individuals to be evacuated and the airfields in Germany where they were located. G-1 Twelfth Army Group then phoned the Combined Air Transport Operations Room (CATOR) at Supreme Headquarters and outlined the situation in all army areas. Upon receipt of the information, CATOR made an analysis of the air supply missions to be flown the next day and notified army group how many individuals would be picked up from the various fields by aircraft returning from the supply missions. If aircraft were available, special evacuation missions were set up apart from air supply. CATOR assumed the responsibility of negotiating with the communications zone and with the British as to the destination of the various nationalities. In general, U.S. personnel were evacuated to the Paris-Le Havre area in northwest France, British personnel to England, and French and Belgian personnel to Paris. Later, the Army G-4s included bids for air lift for recovered personnel with their bids for air supply, which were made direct to CATOR.

Original plans contemplated a rather detailed documentation and processing of recovered U.S. personnel before their evacuation to the communications zone. When it was seen that such procedures would materially delay evacuation and repatriation the only requirements were that rosters, by plane load, be made out certifying that all persons whose names appeared on the rosters had been deloused. Army commanders were charged with the responsibility of allowing no individuals classed as security threats to board the aircraft.

It was necessary for all armies to designate one or more battalions to operate staging areas at airfields in Germany and to otherwise care for the great numbers of prisoners pending their evacuation. Normal procedure saw the prisoners deloused, divided into groups of twenty-five, group rosters made out, and the groups held together pending embarkation. Every effort was made to reduce loading time to a minimum in order that the maximum number of individuals could be evacuated during any particular day. Administrative difficulties and back-logging were of course encountered, due principally to diversion of aircraft because of weather or emergency missions. Taken as a whole, however, the operation may be classed as eminently successful in that it gave thousands of individuals the opportunity to receive needed medical treatment in the shortest possible time and lifted their morale by giving them an immediate start on the long trip home. During the period 6 April 1945 to 14 May 1945, 338,929 individuals were evacuated from Germany under this program, 70,932 of whom were United States military personnel.

Airborne Air Base

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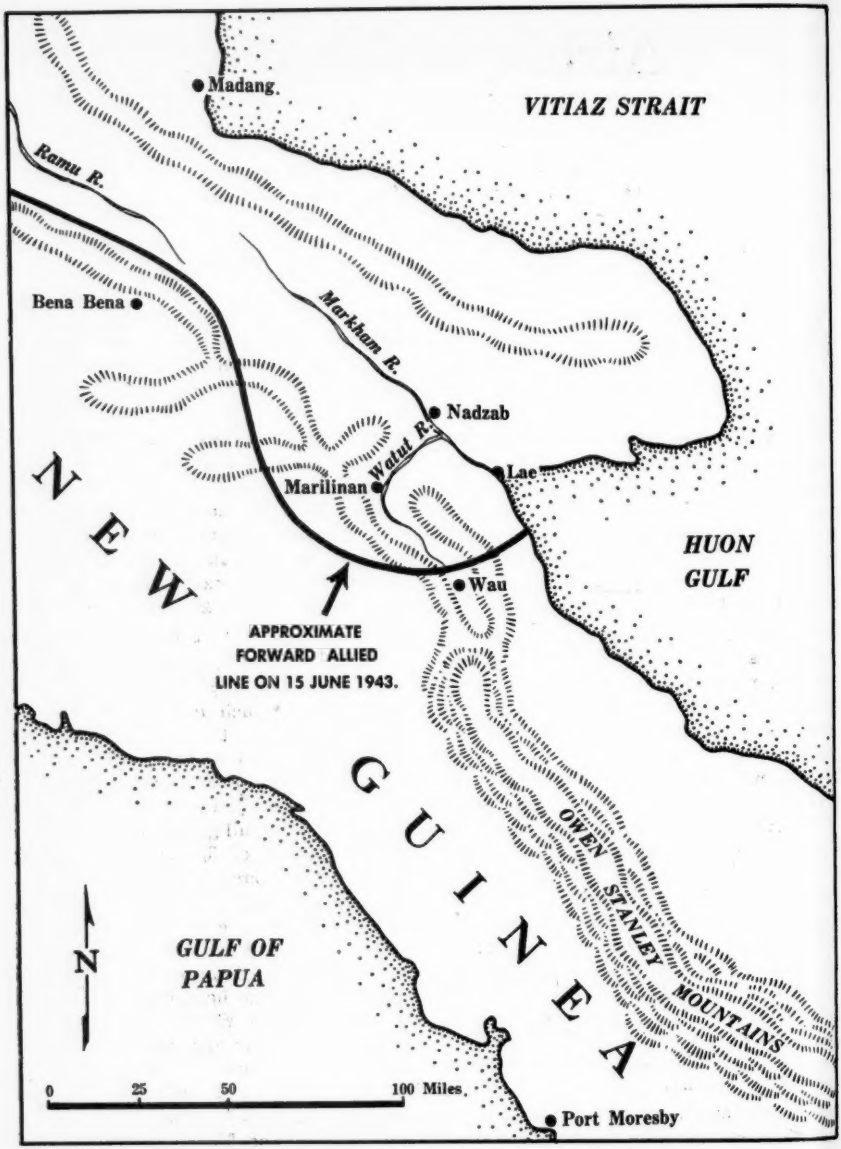
Introduction

AT dawn, 15 June 1943, four C-47s with a covering squadron of P-40s took off from the main air field at Port Moresby and headed northward over the New Guinea jungle. They climbed high over the crowded peaks of the Owen Stanley Mountains and then dropped slowly down toward the low overcast which blanketed the Jap ground below. There were a few anxious minutes of circling, hunting for a break in the clouds, when finally the Aussie guide—an old New Guinea bush pilot—said softly, "There it is." The big planes started a tight downward spiral, one instant in bright sunshine, the next smothered in the soft grey mass of the cloud bank. Suddenly they broke through the overcast to find themselves in a four to five mile wide river valley, jungle-covered except for a few bright fields of *kunai* grass. Mountains pushed up into the clouds on either side, and closed in rapidly to pinch off the valley at its head a few miles to the south. The lead C-47 turned toward this pocket, dropping slowly toward the ground. Some human specks could be seen, frantically placing tiny white panels on the last patch of *kunai* before the mountains closed in. The plane slowed abruptly as wheels and flaps went down. It skimmed a small swamp, touched its wheels quickly on the soft *kunai* sod, and braked hard to a stop just short of the gully at the far end of the tiny field. With hushed motors, the other three C-47s followed in to safe landings. Doors banged open and men and supplies poured out of the planes for a brief few minutes. Then, one by one, with motors roaring at full throttle to pull them clear before they hit the sucking mud of the swamp, the planes took off down the valley and disappeared into the protecting clouds above. As they left, their crews looked back at the spot they had visited so briefly, but the jungle had swallowed all trace of their visit except for a few faint wheel tracks in the *kunai*.

This was the start of a little-known operation which played an important part in paving the way for General MacArthur's rapid push up the north coast of New Guinea to the Philippines. Two months later there had sprung up on the banks of the Watut river, some five or six miles down valley from where the first C-47s landed, a full-grown fighter base. It housed a group of fighters, protected by its own local ground forces, "ack-ack" and radar, and serviced by its own local maintenance, engineer, communications, medical and supply units. This base, known variously as Marilinan or Tsili-Tsili, provided the advance fighter fields so useful for covering the Wewak bomber strikes which crushed Jap airpower on the north New Guinea coast, for supporting the paratroop capture of Nadzab and the amphibious attack on Lae, and for sustaining the drive up the Markham valley which threatened Madang from the rear. And


Madang
VITIAZ STRAIT
Ramu R.
Bena Bena
Markham R.
Nadzab
Watut R.
Lae
Marilinan
HUON GULF
NEW
Wau
APPROXIMATE FORWARD ALLIED LINE ON 15 JUNE 1943.
GUINEA
OWEN STANLEY MOUNTAINS
GULF OF PAPUA
N
0 25 50 100 Miles
Port Moresby

every pound of supplies, every piece of equipment, and virtually every man which made this base a reality arrived by air, far beyond our most advanced outposts, under constant threat of Jap air and ground attack.

While this operation was not unique in all its aspects, it was the first complete combat application of a number of related ideas and concepts, some of which had been tested piecemeal elsewhere. Its importance lies in the fact that it demonstrates fully a type of airborne operation which may well be strategically important in a future war. It proves the inherent practicability of establishing by airborne effort alone an advance air base which can materially extend the effective range of our air striking force. In view of the extreme distances which our bombers may be called upon to fly, an effective means of extending their range could well be vital to our attempt to wipe out enemy centers of production.

Preliminary Reconnaissance and Decision

The decision to establish an airborne fighter base at Marilinan was made by the Commanding General, 5th Air Force, after a thorough study of the tactical requirements had indicated that such a base was absolutely necessary, and after a review of the air lift at his disposal showed that logistic support of the base was practicable. Preliminary reconnaissance by air had already indicated which areas offered the best potential sites, which areas were least affected by the treacherous tropical weather, and which areas were sufficiently removed from the normal patterns of Jap ground and air activity as to avoid early discovery of our operations, thus allowing adequate build-up time. Later, several small ground reconnaissance parties were sent out with native guides from an Aussie outpost at Wau to investigate the most likely sites. Four days of man-killing travel over incredibly rough mountain trails brought one such party to Marilinan. They sent back a brief report by native runner to Wau, where it was relayed by Aussie Army radio and eventually reached "Advon," the 5th Air Force Advanced Headquarters in Port Moresby.

The message, as received at Advon, was garbled and inconclusive, but it did indicate that a long-abandoned mining company landing strip might be used, at least to establish direct contact with the Marilinan party. By this time, the dry season during which the operation was to take place had started, and the need for accurate, complete information on the Marilinan site had become urgent. The only quick way to get any information at all was by air, and the best way to get enough information on which to base a sound decision was to send a senior member of Advon to check the site on the ground. A flight through Jap air meant an experienced combat pilot in a fighter plane, and a fighter landing at Marilinan meant a seasoned flyer who knew his plane's performance to perfection. Rather than risk a less-qualified junior officer, the Commanding General of the 5th Fighter Command went on this mission himself. With his executive, flying wing-man for him, he left Port Moresby the morning after receipt of the Marilinan message. They fishtailed and power-stalled their P-40s in to a landing at Marilinan, quickly decided that the old mining strip was unsuitable, inspected a large *kunai* plain a few miles away and approved it for the final site, and flew back to Port Moresby in the late afternoon. That night, at Advon, final plans were made and approved, and the first C-47 flight left for Marilinan the next morning.

Conduct of the Operation

Those first four C-47s carried a small but balanced advanced party, charged initially with opening up the approved site for extensive air transport use at

the earliest possible date. It included a handful of air engineer, medical and radio communication personnel, a platoon of Aussie infantry to provide a warning screen against possible Jap ground action, and two men for administering and directing native labor. Equipment was limited to a radio capable of direct communication with Port Moresby, one all-important jeep, and a stock of hand tools for use by the native labor to be recruited. Supplies consisted mainly of rations, gasoline and ammunition, plus trade goods for pay of the natives. The party was commanded by the Air Engineer, 5th Air Force, who had been designated as commanding officer of the base, with full responsibility for all activities thereat until such time as the fighter group arrived, when command would pass to the fighter group commander.

Work commenced at a furious tempo which never relaxed from the moment the advance party landed until two months later when the base was finally in full operation. All hands pitched in to move cross-country down the valley from the mining strip to the new site. The Air Engineers staked out the first runway and unloading area; men, women and children from the two native villages in the immediate vicinity were put to work clearing and smoothing the runway; the radio men set up their station and established contact with Advon; the Aussie platoon pushed its outposts cautiously down the valley. A week later the first few C-47s landed at the new site, and from that point on the work advanced rapidly with the build-up of men and supplies. The 871st Aviation Engineer Airborne Battalion, just off the boat at Port Moresby, soon replaced the native hand labor; the Aussie platoon became a battalion; the Fighter Control Squadron set up its local radar and tied in with the main net; the Service Squadron organized its aircraft maintenance and supply facilities; and the medicos converted a patch of jungle into a complete, small hospital with a special clinic for the natives. The airfield grew from the first rough 3,000 by 100 feet of stubble, to three long, smooth hard-packed dirt runways with taxi loops and parking bays, which at its peak handled the landing, unloading and takeoff of 200 C-47s in four hours—a landing or take off every thirty-six seconds.

How it was that the Japs were blind to all this activity for almost two months is a mystery never explained. Only thirty-five air-miles separated Marilinan from the big Jap base at Lae, yet their Markham valley patrols never attempted to penetrate the Watut valley, and apparently never reported the air activity which must have been observable from their normal patrol routes only twenty miles away. Their radio intelligence should have picked up and located our radio and radar stations early in the game, but never did. It was not until a lone Jap reconnaissance plane, off the beaten track, flew overhead on 14 August and spotted what was now a large air base that the fireworks began. Two Jap raids that night, a third the next day, a fourth the second night and a fifth the second day. But that was the end for on the third day our bombers, supported from Marilinan, hit the Jap airfields at Wewak, and no Jap plane ever bothered Marilinan again, striking proof of the effectiveness of the Wewak strike.

A partial explanation of this Jap blindness lies in the measures taken at Marilinan to conceal the activity there as long as possible, and in the action taken by Advon to confuse the Japs as to our ultimate intentions. All initial work at Marilinan followed a rigidly controlled pattern designed to take maximum advantage of natural camouflage potentialities. For example, the burning of *kunai* grass in dry season was a normal native activity. Hence irregular patches of the grassy plain were burned off in such a way as

to make the landing field unrecognizable from the air, with such success initially that our own planes sometimes had difficulty in finding the site. After the engineer battalion started work, such concealment measures rapidly lost their effectiveness, but even at this stage the pattern of disturbed ground was kept as irregular as was practicable so as to gain some advantage in keeping the site less obvious to stray Jap planes. Radio security measures included minimum activity by the Marilinan radio, and the use of a special block of code words, changed periodically, for reporting weather, status of work, and enemy activity. Native traffic into Jap areas was blocked by special patrols of native police boys, with severe punishment for all offenders. Deceptive action taken by Advon included concurrent airborne base construction at Bena Bena (which drew Jap attention and air attack long before they discovered Marilinan), and special air activity in the Markham valley by the transport fighter cover to divert attention from the transport landings at Marilinan. All these measures might reasonably have delayed discovery for three or four weeks. The extra month of grace can be considered only as a lucky break.

The supply and build-up of Marilinan by air involved several problems of special interest. The primary supply impetus came from Advon, where the A-4 successfully arranged the amounts and timing of shipments so that the small staff at Marilinan was almost never concerned with ordinary supply matters. The Marilinan radio kept Advon closely informed as to local weather conditions and airfield capacity so that the available air lift could be utilized most effectively, avoiding bad-weather, and taking maximum advantage of good weather up to the limit imposed by facilities at Marilinan. All transport missions required fighter cover from Port Moresby, which meant that the transports had to land, unload and take off at Marilinan before the fighters got too low on fuel. As the number of transports in a given day's flight increased successively from ten to fifty, to 100, and finally to 200, this required the organization of a carefully integrated system of ground control at Marilinan, in which the control tower, parking spotters and specially trained unloading crews worked as a coordinated team, using jeeps and walkie-talkies liberally in carrying out the pre-determined unloading plan.

The 871st Aviation Engineer Airborne Battalion worked around the clock, seven days a week, to provide maximum airfield, service and camp installations in a minimum of time, and did an outstanding job. Their runway and taxiway work, from initial location through to completion of work, was constantly coordinated by the Air Engineer with the pilot personnel so as to reduce operational hazards to a minimum, with the result that only two aircraft accidents, both minor, ever occurred. Runway alignments were first staked out and then flown by experienced pilots prior to construction so as to insure the best possible approaches in the difficult mountain terrain surrounding the site. Although the battalion's lightweight, dirt-moving equipment had only a limited capacity, the runways were trimmed and graded sufficiently to eliminate even those minor cross-slopes and dips which might have proved dangerous to an unwary pilot. In order to avoid collision between planes and engineer equipment, grading operations on runways already opened for use were frequently done at night, under batteries of floodlights which were clicked off only when enemy or unidentified planes came close.

Conclusion

An account as brief as this must necessarily omit many of the details which helped to make Marilinan a success. But the bare outline given above may possibly help in envisioning the main features

of a similar operation in the future. Marilinan was first reached by a party on foot; but parachute drops, or a glider landing, or use of a small plane might give the same or better results. At Marilinan an abandoned civil landing strip was of considerable help initially; but tracked landing gear will soon make any reasonably level grasspatch capable of receiving the first critical plane-loads of men and equipment. Marilinan was only about thirty miles beyond our outposts; but it could as well have been 500 or 1,000, so long as it was not readily accessible to enemy ground forces in strength, and provided our aircraft ranges had permitted adequate support at the greater distances. Marilinan required two months to build; but better planning, based on better knowledge of this type of operation, and stronger support with more air-lift and better airborne engineer equipment could cut the time to a very few days. In virtually all other respects the tactics employed at Marilinan were the fundamental tactics of war and will apply as well in the future as in the past—concealment, deception, surprise, boldness, and a willingness to take a calculated risk for big stakes will all play their parts.

The lessons learned at Marilinan have not been forgotten. On the contrary, so high an authority as General George C. Kenney, Commanding General of Strategic Air Command, recently stated that they will play an important part in any air offensive of the future. Nor should the possibility of enemy use of this maneuver be overlooked in our defense plans, for in the wilds of northern Canada there are a hundred potential Marilinans. In the past, an air force has been tied to slowly-built, fixed bases. In the future, the air force will move its advanced bases by air to any desired point on the globe in a matter of days, or even hours. The airborne air-base will be to the air war of the future what the floating naval base was to our Navy in the Pacific in World War II.

The next two years will see the evolution into form of the new National Defense Establishment. The Air Force will cooperate to the utmost with the two senior services. It is our hope that, by working together as one team, there will be created a military establishment which is unified in spirit as well as in planning and operations, and dedicated to the maintenance of the security and integrity of the United States.

General Carl Spaatz

LEADERSHIP as a Health Factor

Carl H. Jonas, M.D.,
Former Major, *Medical Corps, A.U.S.*

"WE lived in hope. The guys who gave up hope died." In so many words one repatriated American soldier after another explained what he considered was the deciding factor in keeping him sane and alive through those long years from early 1942 till late 1945 while he was a prisoner of the Japanese.

Man after man, the account followed the same theme: "I knew we'd be rescued if we could just hold on long enough. I never gave up hope that I'd be home again." These men who survived had no doubt in their mind that they would be rescued. Through all those years of gradual starvation, disease infested living conditions and exhausting days of labor, their steady faith and hope played a major role in maintaining life. These men offered their own observations to support their contentions. They listed examples of fellow soldiers who had the same body weight and lived under the same conditions who gradually gave up hope that they would be rescued. In a short time, these men ceased talking about home and withdrew from the comradeship of the group. In seclusion they rapidly weakened physically and died. The repatriates pointed out that the changes leading to death in many cases started with a despairing attitude that rescue would never come, that they had been abandoned by their countrymen.

Such reports as these have been a source of interest to astute observers and medical men for centuries. They are reports which are difficult to interpret in terms of physical science. Probably because of this difficulty scientific observers are prone to dismiss them too easily as belonging to the realm of metaphysics instead of science.

However, the claims of these repatriates, the claims of Rickenbacker and his crew mates, twenty-four days adrift in the Pacific, and countless similar experiences in this past war and the years before have accumulated too much evidence that attitudes and motivation do have a physical effect on an individual's resistance to disease and death. Lending further emphasis to this concept were the experiences of almost every medical officer in the service who provided treatment for injured or ailing service men. In spite of the most skillful surgical and medical care there was still an unaccountably high percentage of cases which failed to produce satisfactory results when compared with their peace time equivalents. With this increase in the incidence of therapeutic bankruptcy, more and more medical men became interested in investigating the motivation factors as a preventive against illness and injury and as an ally to the medical officer once illness or injury occurred. Investigation by both medical and non-medical observers removed much of the mysticism from the high casualty and illness rates in certain military units and brought the study of the sustaining power of good

motivation into the realm of physical science to a degree never seen before.

The investigations indicated that the role of the officer in protecting the mental and physical health of the soldier demands a lot more of him than merely teaching the principles of first aid and the location of the nearest aid station. To a large extent, the prevention of casualties and illness within the command depends on each officer in that command. Even the rate of recovery, or failure to recover from an illness or injury is in part a measure of the quality of the line officers as well as it is a measure of the skill of the medical officers. The interpretation of this apparent paradox lies in the individual's motivation.

Although there are certainly many complex factors which serve to strengthen a man's determination to live through and overcome what are ordinarily classed as over-whelming threats and obstacles, a few of these factors have been identified and their connection with casualty prevention has been demonstrated.

Personality of the Leader

One of these factors is the personality of the man in authority. The emotional maturity of the leaders has been proved to be of tremendous importance in warding off casualties in the soldiers of all ranks who are exposed to these leaders. This conclusion which has been carefully investigated is by no means strange to military men but the qualities of good leadership have not been so clearly defined before. One of these qualities is the ability to recognize that as officers we have an effect on everyone with whom we come in contact. We must have the ability to identify quickly the effect we are producing and be able to get the one we desire. This is more generally referred to as inspirational leadership. Because of our education, social position, rank and authority, we are in a position to do great benefit or harm to the mental attitude of our colleagues and our subordinates.

We have all seen an officer who has in a grievous way failed to fulfill these requirements of his position by continuous ridicule of military strategy, by passive insubordination to his own superiors, by seditious innuendos about the cause of the war, by tardiness and by subtle or flagrant disregard for cooperation. We have all seen an officer who is himself so poorly motivated for giving service to his country that he tries to deny his weakness and bolster his own flagging emotions by cruel and unwarranted discipline of soldiers who come to him with complaints originating from the same failing spirit. In using cruel or obviously unjust measures the officer may temporarily keep his own weakness in check, but in so doing he has weakened the morale of all those who witnessed the episode or who may later hear about it by rumor. We have all seen varying degrees of behavior of this type in officers who are unaware of the fact that they are spraying venom for those around them to absorb. These officers may be technically skilled and admired, but the good they do in a tactical way is overbalanced by the insidious decay they leave in their wake in terms of dissension, doubt and despair. These emotions engendered by a poorly integrated and motivated officer can become extremely dangerous under the stress and strain of isolation and combat and produce more casualties than tactical skill of the commander can save.

So it may be said that the first factor in the role of an officer as the protector of the mental and physical health of the soldier is the attitude of the officer himself. He must learn the requirements of good leadership and adapt his own behavior so that it lends itself to the formation of a strong ideal in his subordinates and his associates. If he fails to do this, he will in some degree destroy in his sub-

ordinates the will to do, the hope of survival and the strength to resist the avenues of disease.

Belief in Your Cause

After looking to our own hygiene, we may look to the other factors which increase resistance to disease in the Army. There is the matter of belief in your cause. If the soldier is to have the fullest possible protection against the undermining feelings of fear, separation and privation which is bound to be associated with any type of military service, men must have the protection of the deep inner belief in the cause for which they suffer these painful onslaughts. Fear, separation and privation tend to destroy hope, cause carelessness and apathy. Out of these feelings come accidents and disease. A belief in the cause for which we fight makes the pains and risks of war purposeful and worthy of endurance. Out of these feelings come incentive, determination and hope. There is no need to develop this point any further. Historians and militarists alike have seen the value of a belief in the cause and how it actually saved lives by making a band of a few hundred soldiers capable of vanquishing a thousand otherwise equally matched soldiers who were without a belief in their cause. The line officer has as his responsibility the detection of the absence of belief or the failing of belief in the cause for which we fight, and should seek to correct this loss by proper indoctrination and example, or by seeking the advice and assistance of properly designated authorities. For it has been learned that an increase in illness and injury may be related to the decline in motivation.

Group Identity

Another factor which has been found to play an important role in the prevention of disease in the soldier has been the ability to identify himself with the group. Group identification can be developed by plan and forethought on the part of the leaders in the group. It is a beneficial trait in the prevention of disease and death because it is the force which makes a man rely on his fellowmen, trust them, and gain physical and emotional support from their presence. It is one of the motivations which enables a man to live courageously and generously because he wishes to keep the esteem and confidence of his fellows. This factor in motivation has been widely reported by psychiatrists and observers of all types. It has been recounted that our American soldiers in this past war had no strong belief in the cause for which they fought and that their courage and sustaining power was almost entirely maintained by group motivation. False inferences have been drawn from this knowledge to the effect that group loyalty is the most potent of the motivating forces. To draw this inference is to be akin to a man who deduces that since he can see very well with only one eye, the other eye must be superfluous. It is essential in any fighting force that we use all the factors available to reduce casualties and protect the health of the group. In this last factor, group loyalty, the officer again must recognize a new responsibility. He must keep the men under him closely knit as a team, properly informed of the important role they play for the bigger group. They must be given the opportunity and the knowledge necessary to take pride in their work. The officer must take pride in his work and show his pride in his speech and in the manner of executing his duties. The safety of the men is dependent upon it.

Religion

There are other factors which are less clearly understood and still more which are yet to be discovered. One of the factors protecting the health of the soldier is religion, although just how it works is not understood medically. Yet thousands of soldiers get strength out of their re-

ligion and because of it are better able to withstand the otherwise apparent hopelessness of war. The officer is obliged to accept the value of religion for those who gain protection through it. He is only defeating his assigned duties if he ridicules or belittles the religious belief of others. To decry the beliefs of others by pseudo-intellectual remarks helps to increase the casualty rate. Even the Russians learned this, and during the war made every concession to the religious inclinations of its citizenry and Army.

Four factors then have been enumerated and discussed. They all play an important part in the health and welfare of the soldier. There is much more to learn about those factors before they and others like them can be fully utilized by the officer to develop the best physical and mental health in the soldier. These factors at first appear to be unrelated to military science, but when we see that without them casualty rates increase enormously, and the problem of getting enough replacements alone actually threatens a military strategy, brilliantly conceived and executed, then we know these factors are in the realm of military science. We must learn to work with these factors if we are to execute the duties of our position to the best that our knowledge will allow.

Leadership is the greatest problem in building an army, as it is in building a college, a church, business or an industry. Meeting this demand for leadership is our greatest national necessity. Leadership must be developed over long periods of time, by coupling education or training with actual experience. Under any system of universal training, *leaders in the Army, the Guard and Reserve, would have ideal means to develop.*

Lieutenant General Raymond S. McLain

A Plan for
Flying Safety

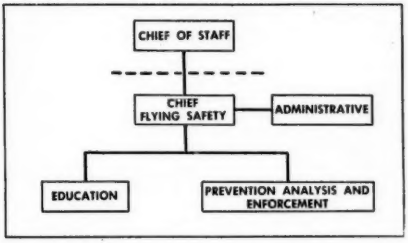
Lieutenant Colonel L. C. Hess, *USAF*

WHEREAS this article was conceived to expound on the whys, wherefores and staff aspects of flying safety activities, it might be worthwhile to outline briefly the location, sphere of action, and physical dimensions of the Caribbean Air Command, since the plan to be discussed originated there. The area includes some 1,500,000 square miles of jungle and water and is generally bounded by the 90th meridian on the west, 62d meridian on the east, and from the equator to 20° north latitude. Using the Caribbean Air Command Headquarters, Albrook Field, Canal Zone, as a center, the radius of action to the extremities of the command is approximately 1,400 miles.

The physical dimensions of the command, plus the accompanying varied climatic conditions, have a definite, far reaching effect on all types of flying. As indicated on the accompanying map, the area extends from the arid desert regions of West Ecuador, Peru, and the Galapagos Islands to the plateau and jungle area of Central America, through the Antilles chain, and back again to Panama. "Weather," as commonly referred to by pilots, exists generally throughout this entire area; in fact, a considerable portion of the area is constantly blanketed by the so-called tropical front which carries with it tremendous thunderstorm activity. This weather factor, plus thousands of miles of uninhabited jungle, uninterrupted water area, and mountainous country with only sketchy information on altitudes, poses a flying safety problem far out of proportion to the actual amount of flying being conducted, and this is considerable.

Major General H. R. Harmon, commander of the Caribbean Air Command, originally conceived the idea and necessity for a flying safety program in this area. Based on his original requirements, a plan was developed that is presently the basis for flying safety activities conducted in the command.

This plan called for flying safety to be established at command level as a special staff section with all the rights and status that go therewith. This section is presently organized as follows:



Decision to create a flying safety section with special staff autonomy required a good bit of thought. Many organizational trends have indicated that flying safety, because of its connection with operations, should be considered a sub-section of A-3, and on the other hand, because of its in-

AIRLINE DISTANCES
IN THE CARIBBEAN
AND
NORTHERN SOUTH AMERICA
MORRISON FIELD
MIAMI
50
287
1010
NEW ORLEANS
547
BROWNSVILLE
TAMPICO
219
216
194
TO SAN DIEGO
1232
MEXICO CITY
306
TEHUANTEPEC
177
VERA CRUZ
153
MERIDA
137
CARMEN
172
MINATITLAN
183
CHETUMAL
157
COZUMEL
264
BATISTA FIELD
423
218
CAMAGUEY
375
BOWEN FIELD
252
BONINQUEN FIELD
SAN JUAN
BOURNE FIELD
COOLIDGE FIELD
202
205
BEANE FIELD
190
LOSEY FIELD
WALLER FIELD
305
ATKINSON FIELD
187
ZANDERY FIELD
168
LA GALLION
446
BELEM
VERNAM FIELD
553
HAVANA
431
PUERTO CABEZAS
383
PUERTO BARRIOS
TEGUCIGALPA
431
GUATEMALA CITY
TAPACHULA
SAN JOSE
SAN SALVADOR
MANAGUA
185
SAN JOSE
DAVID
RIO HATO
699
TUMACO
807
GALAPAGOS ISLANDS
897
599
625
TALARA
157
SALINAS
QUITO
246
110
CALI
157
MEDELLIN
BOGOTA
378
PUERTO CARRENO
BOA VISTA
315
490
MANAOS
MATURIN
BARCELONA
LA GUAIRA
MARACAIBO
378
473
1110
345
135
91
133
ORANJESTAD
HATO FIELD
BARRANQUILLA
693
183
263
277
AIRBROOK FIELD
TURBO
377
305
311
130
269
412
125
N

spectional aspects paralleling those of an inspector, some felt that it should be assigned as a sub-section of the Inspector General Section or Air Inspector Section. Although both of these concepts have merit, they are not entirely true, and if followed blindly they would lead to an ineffective solution to the safety problem. Further discussion will clarify this statement.

Organization in any line of effort is established only because of the need to have a job accomplished in a coordinated and efficient fashion. Flying safety is organized and functions for one purpose, the prevention of aircraft accidents. The Air Force probably has the largest investment to be safeguarded of any other single organization in the world.

This investment includes thousands of aircraft, few of which cost less than $100,000 and thousands of pilots in which the government investment runs well into the millions. In addition to the initial cost of Air Force equipment, aircraft are particularly expensive in upkeep and likewise extremely vulnerable to damage. An aircraft involved in even a minor taxi accident usually costs thousands of dollars to repair. In addition to the vulnerability of Air Force equipment, flying is a particularly skilled form of endeavor, requiring an extremely high degree of perfection on the part of the individuals in the profession. The opportunities for pilots and crew members to err with tremendously damaging consequences are far more numerous than in other type of work. The average person often experiences what is known as wandering of the mind, and pilots are not exceptions. This condition, coupled with a sense of false pride, poor judgment, and lack of knowledge, provides the major contributing causes that lead to disaster in the air. The problem of flying safety remains, then, to eliminate or reduce these and other factors to a bare minimum.

For must practical purposes the Caribbean Air Command has four distinct methods of application of knowledge to the accident problem. These methods of approach are covered under Educational System, Guard System, Specific System, and Disciplinary System. A few words of description about each will be worthy of the time, and in turn will clarify why the internal flying safety organization is as it is.

Educational System: Although this system has the least direct application to the problem, it has the most far reaching effects. It depends upon the use of publicity media by which personnel are instructed in the facts of accidents and their causes.

Essentially such a system points out hazards which exist to flying and handling of aircraft, and describes ways and means of avoiding these hazards. Similarly, by making available, in simple terms, data on operation of aircraft and air force equipment, pilots and crew members can gradually be impressed with the proper methods of accomplishing the task. Unknown to themselves, these methods become habit forming. To a great degree the success of any flying safety educational system is dependent upon establishment of a common sense accident awareness in all personnel and fixing in their minds the fact that accidents can be avoided and eliminated. This system stresses that accidents are not to be accepted as a necessary evil in connection with aircraft operations.

A difficulty in putting the educational preventive program in force is the problem of finding qualified personnel endowed with ingenuity, knowledge and foresight. The material these people publish and sell must be of the proper mental level for absorption and must not instill fear, ridicule or resentment in any form or effect. This program can really be classified as

one requiring the highest attributes of indirect salesmanship.

Within the Caribbean Air Command, every feasible type of publicity medium is used for dissemination of facts. Posters, centrally controlled material for pilots' safety meetings, weekly suggestions for flying safety officers, and semi-monthly flying safety bulletins are among the articles used. This material, of course, is supplemented by information obtained from Air Force Headquarters and other major air commands with which this command exchanges ideas. It is particularly difficult, however, to search out examples of how a well constituted education program prevents accidents. Here is one incident worth mentioning. Recently a B-17 belonging to this command developed a fire in flight necessitating crew and passengers to bail out over the Nicaraguan jungle during the night. One of the crew members, who was rescued after many days in the jungle, stated when interviewed that he attributed his survival in the jungle to the fact that he previously had seen a film entitled "Land and Live in the Jungle" and recalled many of the items of survival, demonstrated by the actors in this film, which he put into practice. It can be reasonably assumed that the many other flying safety educational devices have similarly permitted pilots and crews to be in position to relate their stories.

Guard System: The Guard System is one used in the Air Force, in similar form to that employed in industrial organizations. The object of this system is to prevent accidents prior to their happening by use of mechanical means or operational techniques which preclude careless mistakes. The guard approach in connection with flying activities is most productive as a specific cure for inexperience. However, those experienced can profit by it as well. Common use of the guard system is manifest in such things as checklists in aircraft which, if used, prevent the omission of an act or deed that may impair safe landing, take-off or in flight operation of the aircraft. On the other hand, it may involve separation of landing gear and flap control levers so that one will not be confused with the other. In addition, such things as improving airfield landing procedures, eliminating hazards on airfields and improving communication procedures fall under this system. This command has gathered numerous excellent examples where foresight has prevented accidents from happening. For instance, it was observed that many crew chiefs throughout the command were failing to properly block the wheels of their airplanes when parked. This practice consisted of chocking the main landing gear by placing blocks only in front of one wheel and the rear of the other. Under this condition a gusty wind or prop blast could possibly cause movement of an airplane and a resulting accident. Appropriate action was taken to insure that the condition was corrected. Apparently, as it sometimes happens, the word did not get completely around, and at one of our fields an aircraft improperly blocked did get caught in the blast of another plane, did move and suffer damage. That, however, has been the only incident of its kind. On numerous occasions Flying Safety Officers of this command have recommended filling of ditches and similar hazards within the usable parts of airfields. This command has positive proof that such procedures have prevented uncalled for accidents.

Specific System: The Specific System has as its basis the accurate, thorough and rapid investigation of all aircraft accidents. Corrective action based on the investigation of a single accident may vary from the establishment of an additional training requirement to requiring the redesign of the machine in use. This system is highly productive in re-

sults, because immediate and direct action can usually be taken on the findings. It is sometimes regrettable that the facts uncovered by accident investigations were not known prior to the accident itself. If such were the case, this headquarters is positive that many accidents which have happened would have been prevented. Examples of corrective action taken due to accident investigations are extremely numerous. I could relate them continuously. One particular case was that of a P-47 belonging to this command that crash landed on a beach due to engine failure with little damage to the airplane and none to the pilot. Investigation of the accident disclosed a faulty oil line hose clamp which led to oil loss and engine stoppage. Immediate headquarters action directing that all similar aircraft be grounded for examination disclosed that five additional aircraft would have experienced difficulty in the near future due to the failure of this particular assembly. On another occasion a plague of B-17 taxiing accidents hit the command—all due to loss of hydraulic pressure. It was determined that inadvertent moving of the hydraulic selector switch by the pilot, or forgetfulness on his part, was the motivating cause of the accidents. Pending modification to the system, action requiring the switch to be wired in the "auto" position entirely eliminated the problem.

Regardless of the direct application of the Specific or Investigational System, however, alone it is weak and costly, because it depends entirely on the occurrence of an accident. In addition, the system depends upon the availability of extremely well qualified and highly trained individuals in the art of producing and determining the cause of the accident which is sometimes based on meager information. By nature, the system protects commanders in that it requires neither vision nor foresight beyond the preparation of recommendations or writing local regulations.

Disciplinary System: The Disciplinary System in connection with air force accidents is a simple and direct system, and in certain instances, highly effective. The mainstay of the system is to prevent repeated violation of established rules, regulations and procedures. In actual application it varies considerably. Sometimes the guilty person is dismissed, and in other instances less harsh penalties are imposed. Extensive use of a disciplinary system tends to become economically unsound, in that many times services of skilled personnel are lost, and then again it may create an ill-feeling that would result in a morale problem and inefficiency. It cannot be overstressed, however, that violators of the rules should be immediately and sensibly punished. This is particularly important because facts on the records show that violators provide tremendous increase in aircraft accidents.

From the foregoing, it is obvious that a Flying Safety Officer must be well versed in practically all phases of staff operation that pertain to flying and ground handling of aircraft. He must be aware of sound practices in utilizing assigned aircraft and the limitations and capabilities of these aircraft. He must be familiar with airfield layouts and those factors which exist in the vicinity of an airfield that are hazardous. He must have in his make-up certain qualities of the inspector, the observer and the analyst. He must report and initiate action on unsafe conditions or practices concerning flying. He must at all times be cognizant and familiar with the pilot, his thoughts, views and feelings and use this knowledge to advantage in planning programs. He must be familiar with the mechanical functioning of aircraft and the means and methods of maintaining these aircraft. In turn, he must pursue an energetic course of action to bring to the attention of those other staff members the unsafe practices and policies which exist and which they can correct. In so doing, the Fying Safety

Officer's activities involve not one, but practically every staff unit and section of a headquarters in varying degrees. Consequently, the officer responsible for this should be given a free hand to accomplish his work and should not be tied down as an integral part of another staff section. In the Caribbean Air Command, this fact is reflected in the organization of a Flying Safety Section as a special staff section, which in turn is reflected in the same degree of freedom of action extended to Flying Safety Officers and safety personnel in lower echelons of command.

In closing this discussion it might be worthwhile for all commanders to stop, think, and look at the basis for accomplishment of a sound and energetic flying safety program by peering at the facts in retrospect. Most accidents have their origin, not in matériel flaws, but in the heads of the pilots flying the planes. Sound judgment based on knowledge, facts and cold appraisal of one's capabilities and limitations is the keystone to the solution. Knowledge can be developed through study and experience, and with proper guidance, self discipline can be acquired.

The Flying Safety Officer stands ready to enhance wholeheartedly the efforts of the commander to solve these and other safety problems. We of the safety profession feel that the war is not over for the pilot. Right now throughout the world, pilots in aircraft are making momentous decisions. They can be helped to make the right decisions, and accidents need not happen.

The airplane was the distinctive weapon of World War II. The achievements of American aviation during this war are unmatched in military history. The number and versatility of airplanes produced by our manufacturers were such as to give our armed forces and those of our allies complete air superiority before the end of the war. This, coupled with the skill and courage of American fliers, was one of the decisive factors in winning the final victory. Utilization of atomic energy, together with the unprecedented advances of aviation science during the war, all point to the rapidly increasing importance of aviation in terms of national defense.

Additional Report of the Special Committee Investigating the National Program

MILITARY NOTES AROUND THE WORLD

USSR

Aviation Fuel

The Academy of Science of the USSR recently announced a new type of aviation fuel, called "uratol." It is produced from turpentine. The new fuel has high anti-knock resistance and possesses a considerably higher combustion value than iso-octane. The cost of production, however, is much lower than that of other fuels since turpentine is obtained incidently in the processing of scraps of wood. Work has been started on the construction of a plant for large scale production.—*Skrzydlata Polska.*

CHINA

Aircraft Engines

For the first time China is assembling aircraft engines for her own planes in a plant near Kunming, wartime headquarters of the U.S. Fourteenth Air Force.

Thirty-six 1,000-horsepower engines for C-47 planes have been produced, but monthly production is expected to be not more than two or three engines.

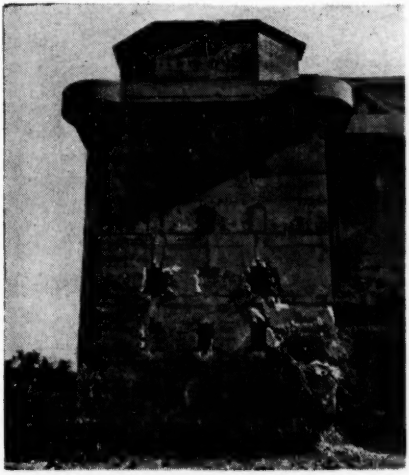
The motors are not completely manufactured in China, because the Chinese are not yet in a position to make some parts. More complicated units must be imported from the United States. The plant's output is not sufficient to meet the needs of the Chinese Air Force, which has deteriorated considerably since the end of the war.—*The New York Times.*

GERMANY

Berlin Flak-Tower

The famous flak-tower, built by the Germans in Berlin for air raids, withstood two recent attempts by the British to destroy it by heavy charges of explosives.

On the first attempt, 50,000 pounds of TNT were used, and the interior was demolished, but the exterior walls were left intact. On the second try, heavy cracks appeared in the walls and a part of the steel reinforcement was exposed, but the sturdily built structure remained standing.—*The Sphere,* London.



Berlin Flak-Tower After Second Attempt at Destruction.

GREAT BRITAIN

Pilot-Ejection Seat

All Royal Air Force jet fighters have been equipped with a pilot ejection seat which overcomes the problems confronting a flyer when he wishes to extricate himself from a plane travelling at high speed. The seat has been successfully tested at 500 miles per hour.

First the hood is jettisoned. Then the flyer pulls a blind over his face, as shown in the picture. This fires a cartridge which ejects him, still sitting in his seat, clear of the airplane's slip-stream. The blind also protects a flyer from the rush of air.

A small parachute or drogue, stowed behind the flyer's head, then opens and slows the seat down to about 150 miles per hour. The flyer then falls forward out of the seat and opens his own parachute, while the 80-pound seat drops rapidly to earth.—*The Illustrated London News*, and *The Sphere*, London.

BRAZIL

Oil Discovery

As a result of new oil discoveries in the State of Bahia, Brazil hopes within ten or fifteen years to meet the country's annual needs of 16 million barrels of oil. Most of the oil now used in Brazil must be imported. There are now forty producing wells with a potential capacity of 4,779 barrels a day. The government has set up a company which will have a plant near Salvador, Bahia, with a capacity of 2,500 barrels a day. Two other refineries, with capacities of 8,000 to 10,000 barrels, are to be built in the Federal District.—*Bulletin of the Pan American Union.*

MEXICO

Cadets Visit U.S.

Twelve cadets of the National Military Academy of Mexico arrived in the United States in October to return the visit to Mexico by a group of West Point cadets. In Washington, the Mexican cadets were received by President Truman, Secretary of the Army Kenneth C. Royall, Secretary of Defense James V. Forrestal, and Army Chief of Staff Dwight D. Eisenhower. For five days the cadets were guests at West Point. They were also officially welcomed in New York by the Mayor.—*Armed Force.*

HAITI

Army Reorganization

The President has been formally designated Commander-in-Chief of the Armed Forces with power to confer commissions. The same law transferred commissions in the old Haitian Guard to the Army of Haiti, and military personnel were declared not punishable under civil law for infractions in line of duty. The recent law also transfers the police force from the Army to a civil Rural and Urban Police Corps.—*Bulletin of the Pan American Union.*

NORWAY

Officer Qualities

The Norwegian army journal, *Militaer Orientering*, conducted a poll of 200 soldiers belonging to various branches of the service. Presented in the order in which they were most frequently mentioned, the following qualities were those most appreciated in an officer:

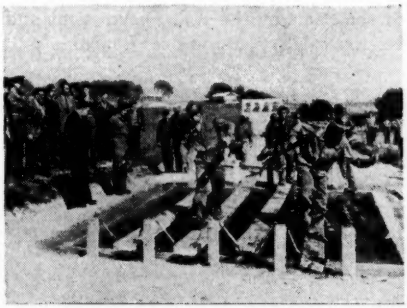
1. Capable in his line; possess an up-to-date education, know what he is talking about, have better training than the soldier or noncommissioned officer.
2. Comradeship; must be able, without destroying comradelike relationships, to maintain discipline, and share the sorrows and joys of his men.
3. Impartiality; must accord the same treatment to all, regardless of position.
4. Temperance. Many remarks and comments showed displeasure with the present situation.
5. Concern for his men. An officer, however capable, will never get the most out of a unit if his men do not feel that he is looking out for their welfare.
6. Resoluteness; must see that every order is carried out, know the thing to do in every situation, never waver, and keep his word.
7. Correctness.
8. Initiative.
9. Punctuality.
10. Politeness.
11. Critical of himself.
12. Diverse in his knowledge, and understand clearly that the men are just as irreplaceable as himself.

This Norwegian poll confirms observations everywhere in the service that the soldier demands much of his officer, but willingly cooperates when he believes him capable but shows very keenly any lack of proper concern by officers. Also it shows that schooling in character and deportment is as important as any other education.—*Allgemeine Schweizerische Militärzeitung* (Switzerland).

FRANCE

Military Training

Rigorous training being conducted at French military camps was recently inspected by Field Marshal Lord Montgomery, accompanied by M. Coste-Floret,



French Soldiers Training at Frileuse.

Minister for War, and General de Lattre de Tassigny, Inspector-General of the French Forces. Field Marshal Montgomery reported the training to be the "best I have ever seen."—*The Illustrated London News.*

ARGENTINA

First Jet Plane

***Pulque*, Argentine Jet.**

The first jet-propelled airplane of original design built in South America is the Argentinian *Pulque*, developed by the Instituto Aerotécnico de Córdoba. It is powered by a Rolls-Royce Derwent V. engine. —*The Aeroplane Spotter.*

UNITED STATES

Underground Installations

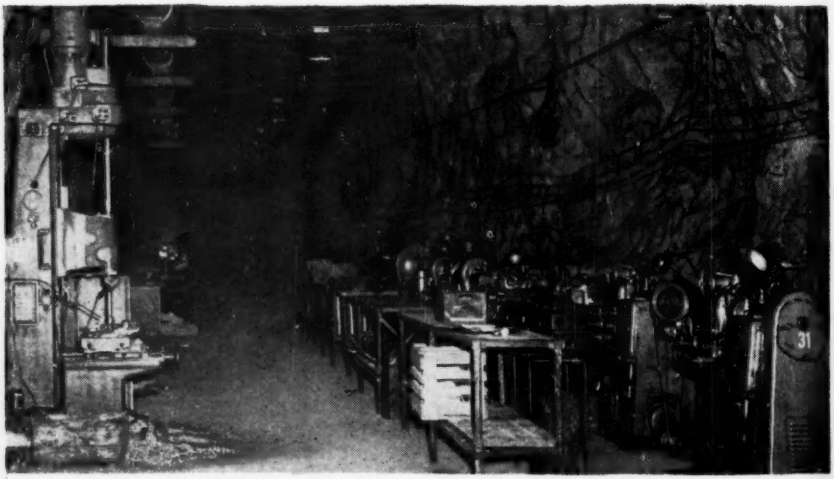
The recent report of Secretary of the Army, Kenneth C. Royall, covering a two year period while he was serving as Under Secretary of War, indicates that underground installations have been under study for sometime by the War Department and the Army-Navy Munitions Board.

In January, 1947, a report on existing mines was prepared by the Chief of Engineers giving facts on certain mines in the United States which are potentially usable as underground sites. Later, the Chief of Engineers was authorized to expend $150,000 to investigate and develop construction and cost factors.

A proposal was submitted by the Chief of Engineers to develop construction and cost data on the moving of a chemical processing plant, now operating above ground, to an underground location where economic, geological and geographical features are best suited to this type of industry. A similar study was recommended on a precision manufacturing plant.

This phase of detailed investigation was approved by the War Department and a fund of $250,000 made available.

The Air Force also has plans to construct a pilot plant underground.



Secret Nazi factory, two miles underground near Thil, France, believed to have manufactured parts for flying bombs.—Signal Corps photo.

Army activities on underground sites are coordinated closely with the Munitions Board, which maintains liaison with other governmental departments, civilian activities, and the Departments of the Navy and Air Force. Early in 1947, studies were conducted in Europe on the problems of underground sites and the dispersion of industry.

Among the sources of information utilized for underground installations is the National Speleological Society, which reported on caves that would meet certain specifications as to size and location.

Out of approximately 5,000 caverns listed by the Society, only a few were found that met the stringent requirements. The caverns, or abandoned mines, desired for this purpose are of very large area, with a "level space" of not over 5 per cent grade. The caverns must also be within thirty-five miles of a railroad, have an "overburden" of at least fifty feet, and have no running or standing water of any consequence.

The National Speleological Society reports that for housing large industries, some abandoned mines might be used, but in general it is believed that it would be necessary to make artificial caves. For housing smaller industries, it is believed that there are enough caves in the United States to house them all.

In connection with the problem of the destructive effect of explosives against underground structures, the Chief of Engineers has announced a series of tests which will be conducted at Dugway Proving Grounds, near Salt Lake City.

These tests are designed to obtain information on heavier charges running from 320 pounds to 320,000 pounds of TNT, in keeping with the increased firing power of offensive weapons. Information is also sought on the effects of explosion by bomb or guided missiles.

Two types of targets are to be used in the Engineer tests. One will be a simple structure with four walls, open at the top and bottom, and will be used to measure the force of earth shock. Other targets will duplicate structures used for underground installations, including a heavily protected command post designed to withstand direct hits. One of the targets is a windowless structure which might be used for limited protection against the blast and radiation effects of the atomic bomb.—War Department and news reports.

This Japanese underground arms factory, which was never used, was dug out of solid rock at Utsummiya, Japan.—Signal Corps photo.

Six-Jet Bomber

The recent unveiling of the new experimental Boeing XB-47 jet bomber reveals a plane of radical design, with sleek lines and sharply swept-back wings and tail surfaces. The ultra-thin wings support

six General Electric jet engines in double nacelles inboard and singly near the swept-back wing tips. Its dimensions are similar to the Boeing B-29 Superfortress.—U.S. Air Force photo.

Atomic Testing Ground

Eniwetok, Pacific atoll in the Marshall Islands, has been selected as a testing ground for atomic research, the Atomic Energy Commission has announced.

Experiments will be conducted on peace-

time uses of atomic energy as well as weapons. Installations to be built on the atoll include buildings for equipment, shelters for personnel during tests, control and observation posts, and housing.—Associated Press.

Automatic Trans-Atlantic Flight

An outstanding demonstration of the progress that has been made toward all-weather flying safety was the recent flight of a four-engine C-54 from the United States to England and return. Although fourteen members of the crew and observers were aboard the aircraft, it was not necessary at any time for any of them to intervene in any way with the plane controls except for the two landings at Stephenville, Newfoundland, where there was no ground gear for automatic landings.

The unusual round trip of nearly 8,000 miles, including two crossings of the Atlantic, started at Clinton County Air Base, at Wilmington, Ohio. Eastern terminus of the flight was the airfield at Brise Norton, forty miles west of London.

The flight was the latest high point in nearly twenty years of effort in the Air Force to safely lighten the task of the airplane pilot.

The automatic mechanism used consists of three parts. One of them is the mechanical "brain," described as a counterpart of a dial telephone switchboard into which data is fed for any predetermined course.

Another part is a collection of more or less conventional instruments, which report to the "brain" the miles flown, altitude, time and location, radio bearings, and other data.

The third part comprises the devices which operate all the controls, including throttles, fuel mixtures, propeller pitches, flaps and landing gear, and others.—News reports.

Historic Fort

Historic Fort Point, built during the first year of the Civil War at San Francisco on the site of a Spanish fortification dating back to 1776, is being abandoned by the Army and recommended as a national monument.—*The New York Times.*

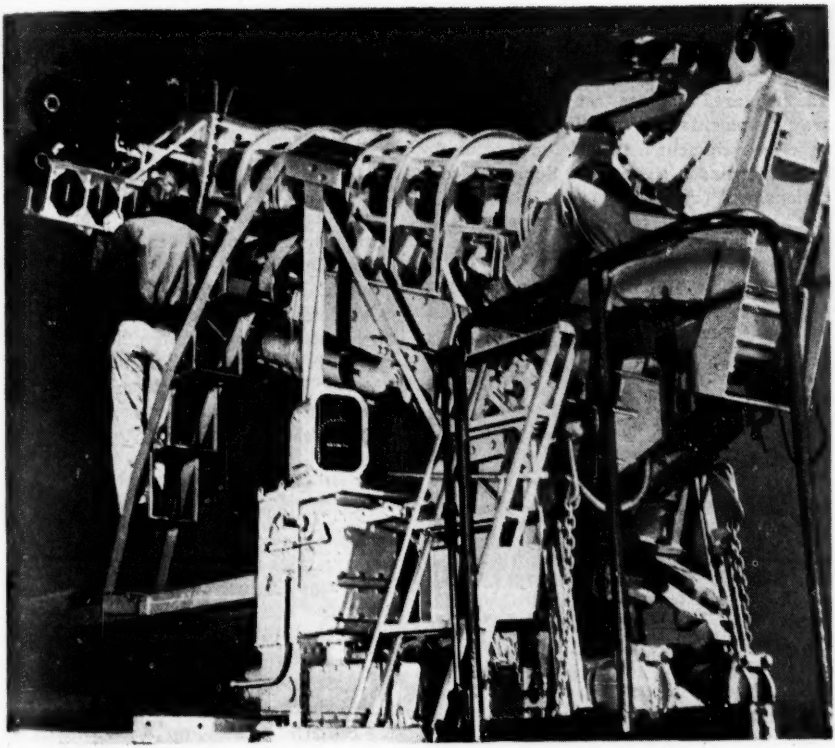
Rocket Tracker

A new 16-inch reflecting telescope on a 90-mm antiaircraft gun mount has been developed by scientists at the Ordnance Department Aberdeen Proving Ground, Maryland, to track visually and photographically the flight of high altitude rockets such as the V-2.

In use, the telescope will be sited on an 8,000-foot mountain peak thirty-five miles from the rocket launching point at White Sands Proving Ground, New Mexico.

Tracking of a rocket with the new telescope will provide a timed record of the entire flight of a missile, make a check of functioning of the controls, and give aerodynamic information during the ascent and the descent.

The photographic recording equipment consists of a motion picture camera using standard 35-mm film and operated at approximately fifteen exposures per second.—U.S. Army Signal Corps photo.



Rocket Tracking Telescope, on 90-mm AA Gun Mount.

Permafrost Research

An unusual project of the Engineer Corps is a long-range plan of comprehensive investigation of the permanently frozen ground of the far North, called "permafrost."

One of the most interesting phases of the project is the Research Area which has been established near Fairbanks, Alaska. The area includes test sections of runway pavements and building designs with precise equipment installed for careful observation under Arctic and Subarctic conditions.

The climate in the vicinity is suitable for formation of permafrost, having a

Building Foundation Studies at the Permafrost Research Area near Fairbanks, Alaska.

mean annual temperature of about 19 degrees, plus, Fahrenheit, with extremes ranging from 88 degrees, plus, to 50 degrees, minus.

The Research Area is divided into three sections for studies of ground and pavement surfaces, runway foundations, and building foundations.

The project is of far-reaching importance, because, with the exploration and development of the world's Polar regions, more and more people will be confronted with the problem of conquering permafrost in order to live.—*The Military Engineer.*

Miscellaneous Notes

Occupation Duties

The decision of the State Department in October to abandon temporarily its plans to take over administration of occupied areas from the Army was attributed to administrative considerations. The State Department previously had indicated it was having difficulty in locating suitable administrators for such duties.—Associated Press.

Language Training

The Army has established a broad program for training selected military personnel in foreign languages, to produce qualified linguists and area specialists to meet demands of occupation duties, military missions, and foreign liaison. Training will be given in Russian, Japanese, Chinese, Turkish, Greek, Persian, Arabic, Korean, Spanish, Portuguese, and French. —Department of the Army.

GI's in Latin America

During 1947, there were 365 American veterans studying in thirteen Latin American countries under the GI Bill of Rights. The members enrolled in the respective countries were as follows: Mexico, 272; Cuba, 25; Guatemala, 15; Chile, 11; Peru, 9; Brazil, 8; Costa Rica, 8; Argentina, 5; El Salvador, 4; Uruguay, 4; Columbia, 2; Dominican Republic, 1; and Honduras, 1.—*Bulletin of the Pan American Union.*

No Longer Secret

A patent has been issued by the United States Patent Office on the Norden bombsight, the carefully guarded secret of the Navy for more than fifteen years. The patent was finally granted to Carl L. Norden and Theodore H. Barth, on an application filed by them seventeen years ago, but the bombsight still remains the property of the government.—*The New York Times.*

FOREIGN MILITARY DIGESTS

The Greek Army and the Guerrillas

Digested by the MILITARY REVIEW from an article by Cyril Falls, in "The Illustrated London News" (Great Britain) 27 September 1947.

GREECE still remains the theater of ideological campaign between Democracy and Communism, between the political theories of Eastern Europe on the one hand, Western Europe and the United States on the other. The consequences of Greece being brought into the Communist-Slav *bloc* would be to alter the strategic balance in the Mediterranean, to the disadvantage of the Western democracies, of their friends, and of their political interests and prestige. The most important and most obvious result would appear in the Aegean. It may be accepted that access to this sea would be barred. The gate, which is Crete—with what might be called gate-posts in the Peloponnese and Rhodes—would be given new warders. The Cyclades and other islands to the north would become so many strongpoints, linked to the Greek mainland by air and water. A combination of air power and minelaying could render the Aegean virtually impenetrable. Pressure upon Turkey for a Russian solution of the problem of the Dardanelles would follow sooner or later, and would in these circumstances be far more difficult to resist, either from within or without.

This represents the most prominent aspect of the present situation in Greece, but there are others which cannot be neglected. The Aegean is also a passage into the Mediterranean. If the northward passage were to be blocked, and the southward were to be facilitated, the effect would be apparent all over the Middle East and even farther afield. From the purely British point of view, the position of Cyprus would be imperilled to begin with. Reactions in Italy, and through Italy in the Adriatic, have to be considered, not forgetting that there exists a strong Communist party in Italy. This strategic background gives a special significance to the military operations in progress in Greece. They take the form of mountain fighting between relatively small bodies of troops. Divorced from their strategic setting, they might possess no more than a local, academic, or technical interest—and for the student of war they have the last in full measure—but as matters stand it is worth everybody's while to pay some attention to them, because so much may depend upon them. They have not gone altogether favorably for the forces of the Government in that these have not been able to effect all that they set out to do, though they have effected a good deal.

One of the original centers of Communist revolt in Greece was the northern part of the Pindus range. In this area the Greek Army succeeded in clearing a wide belt, an exceptionally difficult operation. Since then, through the heart of this former guerrilla stronghold, it has established and

maintained a line of communications running from the coast at Volos through Trikkala. Based upon this line, the Greeks hoped to continue the offensive against the rebels to the north and northwest until they had cleared all the country up to their frontier. When this had been accomplished it would be time enough to deal with groups of rebels in other districts. The further offensive, however, has not so far achieved a similar success, and the latest drive in Epirus has proved disappointing. The feat of clearing and keeping open this big zone in the Pindus has been a fine one, but it has involved stress. Large numbers of troops have been required for the purpose of outposting this mountain area, forces so large as to diminish seriously the strength of those left to attack the further guerrilla bands to the northward and push them back to the frontier. The theory is that if the frontier were to be sealed, there would follow a reasonable measure of security and repose. It may be so, but it is my belief that determined men would always find a way through, even though the frontier is one with few avenues through it. In any case, it is, as yet, very far from being sealed.

So what was meant to be a step-by-step advance, each consolidated area providing a foothold for the next move, appears to have become blocked, more by the using up of its manpower than by the direct opposition of the enemy. Now the season is growing late. It would seem inevitable that the sealing of the frontier must be postponed until next year. I need hardly explain why the Greek Government is so anxious to do this. It is because of the conduct of the three Slav countries which have been supporting the rebels in Greece: Bulgaria, Yugoslavia, and Albania. That they have been doing so is no longer matter for dispute. In fact, their support has just been described by Mr. Marshall as a direct threat to the political independence and integrity of Greece. The rebel bands have received substantial aid from them, coupled with the valuable privilege of leave to cross their frontiers when it suits them to do so. So far, the Yugoslavs have been the most prominent in this respect, but the Albanians have not been far behind them, and of late there has been increased pressure by the rebels in Thrace, with Bulgarian connivance. Nor is there any serious doubt that the general policy at least has been adopted in consultation with Russia, the patron of these Slav States. On the other hand, there has not been the slightest substantiation of rumors of direct Slav participation. Heavy losses have been inflicted upon the rebel bands, but no Slav has been found among the dead.

The total numbers of the rebels are surprisingly small. They are believed not to exceed 12,000, and even of these only a proportion, perhaps as little as one-third, can confidently be classed as out-and-out irreconciliable Communists. At the other end there are a large number of impressed, and in some instances possibly reluctant laborers and carriers. The bands are often small and are widely scattered. Their greatest strength lies in the neighborhood of the Slav countries from which they derive support. They are also to be found in the southern Pindus and south of the Thessalian plain. Here they lie on the flank of the main Greek line of communications already mentioned, but have been unable to interrupt it to any serious extent. On the shore of the Gulf of Salonika they have nested in the fastnesses of Mount Olympus and Kissavos, the classical Ossa. They are well enough armed with light weapons. They employ mortars, but there has not been a single credible report of a mountain field gun. They can move rapidly because they live on the country and do not have to consider the angle of communications. In fact, they have no

communications, except to some small extent across the frontiers of the Slav countries.

The latest major operation affords an illustration of the difficulties with which the Greek Army is faced and of the value of the frontier as a screen to its opponents. It also exhibits the guerrilla tactics of the latter at their best. This operation began in early July. The object of the Government forces was to envelop and destroy one of the largest of the bands, estimated to be 2,500 strong, north of Konitsa. Ironically enough, the area of operations was one in which the Army had gained some of its finest triumphs over the Italians. Three columns converged simultaneously on the area. Some hitch must have occurred. A big body of the rebels broke out eastward, crossed the Albanian frontier, and moved south behind it. It then split in two. One half turned back into Greece at the level of Konitsa and launched an attack on that place. The other held on south for some miles and then also entered Greece, to cut the Greek Army's communications between Yanina and Konitsa. A third party broke out to the south. The result was to take the steam out of the offensive. Troops from the main columns had to be moved down to protect or clear the communications. The counteroffensive represented no danger to the Government's forces, but it seems to have caused a diversion sufficient to ruin the enterprise. The last news is that even attacks which have continued against such of the guerrillas as remain in their original station are unlikely to produce decisive results.

Greek armies have always understood their business in mountain war, and that of today is no exception. It is highly efficient. It has, however, campaigned under handicaps. One has been pressure from deputies to defend or rescue every remote hamlet threatened or occupied by the rebels. This has sometimes led to dispersion into small parcels, too weak for these special tasks and not strong enough anywhere for a concentrated effort. This did not apply to the main operation in the Pindus, where success was due to concentrated thrusts, irrespective of minor considerations. Another has been poor cooperation on the part of the *gendarmerie*, which has been responsible not to the Ministry of War, but to the Ministry of the Interior. The *gendarmerie* should, in theory, take over from the troops wherever these have consolidated their success, but its support has often been indifferent. Efforts have been made to keep the Army clear of politics, but the *gendarmerie* is manifestly political and its sentiments are

Greek troops in defensive position near Lake Doiran, Northern Greece. Hills of Yugoslavia are in the background.

those of the far right. There is a third force, which may be called the "Home Guard," divided into two elements, one static and the other mobile, but little information about its achievements is available. Probably it also is strongly right wing.

It would be an exaggeration to assert that a solution of the problem by force of arms is an impossibility, but there does not appear to be any prospect of this occurring in the near future. On the other hand, talk of a settlement by broadening the basis of the Government seems pointless. The extreme left, known as KKE,

would hardly come into the Government unless it saw its way to secure control. The other parties, with recent object lessons in Eastern Europe to study, would not welcome it in. There remains the threat of the proclamation of "Free Greece" by the rebels. The step would have a significance beyond what could be accorded to it on its merits. These are practically *nil*, since the rebels, even where strongest, have no real pretensions to form an administration. They might be hunted out of any particular area, even though they escaped to another. The real object of such a step would be to support a plea to the Slav States for belligerent rights. That would be a new complication. "Free Greece" is more likely to be proclaimed in Macedonia and Epirus than in Thrace. The Bulgarians are the worst hated of the Slavs, so that any suspicion of support to their claims in Thrace would be unfavorable to the rebels.

The British are mainly concentrated near Athens, and Salonika, with small liaison units assisting the training of the Greek Army. They are, as is well known, debarred from taking any part in operations. By a queer, but perhaps necessary convention, the training units are kept out of contact with Greek forces engaged in active operations or which might suddenly become involved in them. They have not been attacked by the rebels. The belief that the small British force now remaining in Greece exercises a steadying influence is one which extends far beyond official circles. The prospect of their early departure is regarded with great regret and no small measure of apprehension. In view of the background already described, it must be a question whether it will be possible to withdraw them in present circumstances, unless indeed they were to be replaced by a detachment from the United States.

Military Operations in Indo-China 1940-1945

Translated and digested by the MILITARY REVIEW from an article in "Revue des Troupes Coloniales au Service de l'Union Francaises" (France) March 1947.

THE Siamese war in 1941 was only one aspect of the Japanese preparation of their offensive against the Allies, and the struggle which began on 9 March 1945 against the French forces in Indo-China was only a consequence of Japan's military reversals in Burma and the Philippines. It may even be said that the Annamite quarrel of recent months is a prolongation of the political action of the defeated promoter of the cause of the emancipation of the yellow race.

In June 1940, a Japanese Army was stationed in Kwang-Si (China) on the Tongking frontier. It was manifesting its displeasure because our railways and highways were being used to supply the Chinese forces. The British were a long way off and the Americans did not yet wish to be drawn into the conflict.

By September, the Japanese were preparing for war. They had two distinct objectives: the total isolation of China, and the pushing of their assembly positions as close to the Anglo-Saxon possessions as possible.

Tongking constituted the first stage in the pursuit of these two objectives. Possession of this region would permit blocking all traffic moving from the China Sea toward southern China, and would permit interference with the Burma Road by establishing air bases in this area. In addition, it brought Burma and Singapore closer by several hundred kilometers.

Through the Germans, the Japanese ex-

erted pressure on Vichy for consent in installing their forces in Tongking. Admiral Decoux caused the negotiations to drag in the hope the United States would intervene. But the Japanese military became impatient and just as a basis of diplomatic agreement was about to be found they invaded Tongking. Our troops were waiting for them, and the fighting began in the vicinity of Langson on the night of 22-23 September 1940.

The disproportion of the forces was overwhelming. On land, there were 40,000 Japanese with superior armament, training, modern planes and tanks, against 12,000 men (3,000 French and 9,000 Indo-Chinese) who were ill-equipped and inexperienced.

On 23 September, after a desperate struggle, the posts of Chi-ma, Dong Dang and Loc Binh fell. On 25 September, the Japanese took Nacham after having suffered very severe losses at the hands of the garrison (1,300 Japanese dead and wounded in thirty hours of fighting). Violent fighting retarded them south of Dong Dang but did not prevent them from completing the encirclement of Langson on the morning of 25 September. On the coastal front, there was an unopposed landing south of Haiphong.

In November and December, revolutionary movements of a strictly anti-French character broke out in Tongking and Cochin-China. Leaders of professional bands, encouraged by the Japanese military, recruited a few fanatics and attempted to exploit the uneasiness aroused by our weakness by proclaiming an independent Indo-Chinese army. At Cho-van near Dongmo, and north of Langmet, the revolutionary Tongking group suffered two decisive defeats by Christmas 1940.

By January 1941, our intelligence service had been apprised for two months that Japanese boats were daily unloading war matériel on the Bankok wharves, along with many "technicians." Thus began the Japanese movement southward.

In order to persuade Thailand to accept this occupation, the Japanese offered them Cambodia and Laotia.

Without understanding the role they were being made to play, the Siamese harassed the French along the extensive Indo-Chinese frontier. We had but a thin line of troops and no reserves but we resisted. On 16 January 1941, two violent clashes proved the effectiveness of our defense. Near the island of Kochang, the cruiser *La Motte-Picquet* and four or five small war vessels sank two Siamese ships, set fire to a third and withdrew with no damage to themselves. West of Sisophon in Cambodia, the main French formation of four battalions and the main body of the Siamese Army moved out simultaneously to the attack. We failed in our offensive, but our blocking attack checked the enemy sufficiently to force him thereafter to act cautiously. As a result, the engagements which followed involved small units only. These occurred, however, all along the frontier in the vicinity of Pailin, Lovea, Svaychek, Samrong, in Cambodia; in the Pakse, Savanakhet, Thakhet and Vientiane areas; and in Laos. The Siamese achieved no success. At several points they even suffered severe counterattacks, especially in the vicinity of Svaychek.

The Japanese now assumed the role of arbiters. The armistice was set for 28 January 1941. On the morning of that day, the Siamese forces began a general offensive against all our strongpoints located on the near side of the frontier. They did not succeed in taking a single one, but though unsuccessful, they claimed the capture of the zone which we had not defended for tactical reasons. The Siamese Army thus laid its claims of victory.

From 28 January to 15 March 1941, guerrilla fighting was carried on over the "armistice front." It was, however, too late to resume a conflict which the Japanese did not desire.

The Siamese affair ended in the cession

of a portion of the Cambodian and Laotian territories.

On 26 July 1941, while the Siamese were entering Battambang, the Japanese effected a junction between their forces located in Tongking and those in Siam. Quietly, while the eyes of the world were turned toward the German-Russian fighting, they occupied the whole of Indo-China, coming within a few steps of Singapore and Rangoon.

The Wait

During the last months of 1942, Allied planes appeared and swept the Tongking skies of all Japanese aircraft. This and the news of the landing in North Africa revived French hopes.

Our task now was clear. We must help the Allies by sending information and preparing for military action in their favor. The forwarding of documents to the Allies concerning Japanese action gradually became our principal task. Networks within the country reported Japanese movements, especially of cargo vessels which became the favorite targets of the Sino-American aviation based in China.

The same networks took care of the crews of the Sino-American planes forced down in Indo-China and saw that they got back to the Chinese zone. Scores of aviators thus escaped Japanese jails. If there were a good many Frenchmen who did not participate in this clandestine action, it was because they had to be discrete in a country where the Japanese were able to recruit so many agents among the Indo-Chinese. In the meantime, the little Franco-Indo-Chinese Army clung to the last quarantees of its liberty—its arms.

The French operational plans provided for mobile groups based in zones that were difficult of access and where food-supply depots had been established, or in fortified sectors capable of immobilizing the Japanese. These projects were combined by secret connections with the French High Command which was represented at Calcutta by a French mission with connections in China. We counted on solid air support from the Allies and aid from a light corps assembling in the Indies. While we waited for these, parachute drops took care of arming civilians and supplying certain units with radio sets.

By autumn of 1944, the situation appeared favorable. News of participation of Frenchmen in the liberation of their fatherland caused the French population of Indo-China to swell with pride. The ratio of forces was in our favor. We were nearly 30,000, including Indo-Chinese. The Japanese were only 12,000, blocked toward China by Allied forces and isolated on the south by the long and narrow coastal strip which was being pounded by American aviation.

Unfortunately, in November 1944, an event upset this optimistic outlook. The Japanese in three weeks' time seized possession of the Chinese province of Kwang-Si, reached the Tongking frontier and announced that they would reinforce northern Indo-China with a brigade and a division. The allied advance in the Philippines and Burma had prompted these measures, but they could not have found a more effective reply to the dispositions we had been making against them. They would soon be more than 40,000 strong in Tongking and it appeared difficult to resist them elsewhere than in the solid fortifications which we had established on the frontier and in the mountains.

Nevertheless, orders were issued that each one was to do his duty wherever he found it. No one was to surrender to the Japanese until he had exhausted all military means. The men of Indo-China were to prove that their apparent silence was not the result of weakening morale.

On 8 March 1945, our intelligence service in Tongking informed us that a Japanese attack was imminent. Nothing happened at once, and in the afternoon of

9 March, the announcement came that the threat was ended.

Defense of Posts and Fortifications

In the surprise attack which followed immediately, the military posts defended themselves until their means were exhausted. Those which were in desperate circumstances refused to surrender and even in cases where there remained only secretaries, employees or sick persons, the Japanese had to attack.

The power of the Japanese was gradually proved. Deficiencies in armament and shortages of men and ammunition were soon evident. The tactics of the detachments which had been able to reach the bush were to defend a zone proportional to their means, contesting it foot by foot. The most favored forces were those whose rear was backed by Allied China.

With a few exceptions, the detachments failed to remain in the bush until the Japanese armistice. Lack of food, fatigue, sickness and treason brought almost all of them into the hands of the Japanese.

The armistice of August 1945 found five men still wandering in the forests of Cambodia, about fifty lost in southern Annam, a few groups which had been dropped by parachute into northern Laos and, particularly, the Laotian group which had originated at Donghene. Due to the great size of the country and the treachery of the inhabitants, these were the only forces able to maintain the French flag on Indo-Chinese soil.

Attempts to fight on in the bush failed because in the areas populated by diverse and mixed races they did not have the support of all the inhabitants. Even in favorable areas there were always informers. Only the Laotians succeeded in silencing these informers.

The following is a brief account of the principal groups organized after 9 March. In southern Cochin-China, unknown to the Allies and without any means of contact with the French mission, soldiers, sailors, reservists, French, and Annamite students attempted to hold out among the canals of this area. Bloody fighting in the vicinity of Soctrang obliged them to take refuge in the "Mangrove," a marshy zone. Many Indo-Chinese became discouraged and abandoned the ranks. On 26 March, a battle in the mud dispersed the last remnants of this force.

In south Annam, there were a number of mobile detachments which escaped from the Japanese but were unsuccessful in coordinating their action. Japan, by falling first on Ban Me Thuot, foiled their plan of making this city the center of resistance. As the Japanese spread over the country, our units concealed themselves and attempted to ambush them, but gradually fatigue and fever rendered them ineffective. Hungry and burdened down with their sick, some of the groups capitulated, but others continued.

The central Annam group was made up of elements which escaped from the garrisons of the Hue area, and they succeeded in reaching the Ataouat, a region so difficult and little known that exploration had been necessary there a few years earlier. This group fought for three months before it was finally betrayed by the primitive populations of the region.

The Laotian group maintained the French flag over Indo-Chinese soil. Made up originally of the Donghene company of Laos and then reinforced by forces coming from other groups and paratroops from Calcutta, it recruited thousands of Laotians who, unfortunately, could not all be armed. They eliminated Japanese agents and rendered great service to the other groups.

Japanese pressure and the hostility of bands of Chinese pirates in the pay of the Japanese obliged the rest of our troops to seek refuge in Kwang-Tung, China. But they found no rest there. Japanese columns from Kwang-Si attempted to destroy them and it required fighting alongside the Chinese Allies to halt them. Gradually our units reorganized and the armistice found them engaged in carrying out forays against the Japanese posts in Tongking.

The territory of Langson on the Japanese invasion route did not organize a group, but it defended its forts and a few isolated units joined the Moncay and Caobang forces.

The Caobang territory comprises very difficult terrain. Our detachments entrenched themselves there but soon found themselves faced with hostile natives. However, our forces clung to the Tongking massif, and it was not till 1 June, after the Japanese had attacked them several times, that they were obliged to cross over the frontier.

The Hagiang area suffered a sad fate. Like Langson, it was already occupied by the Japanese. The latter successively eliminated the little frontier posts before they were able to coordinate their mobile forces.

North of Laokay, regrouped garrisons took up positions near Phalong. On 9 April the Japanese attacked this position and after a three day siege drove them into China.

South of Laokay, as far as Vientiane, passing through Lai Chau, Phong Saly and Luang Prabang, the frontier sectors served as a refuge for the mobile forces of Tong-Sontay.

The group east of the Red River was a formation of battalions and companies which intended to join forces in the Tuyen Quang area. Setting out from widely separated points (Caobang, Langson and Thai-Nguyen), they never met, but formed three distinct groups. The first attempted to establish itself in the Bao Lac area, but harassed by pirates as well as by the Japanese and wholly without food, it crossed into China. The second experienced the same fate in the Dong Van area. The third finished tragically. Ceaselessly attacked by the Japanese, it offered magnificent resistance from Phu Doan to the gorges of Cocpai. There, thirty kilometers from the frontier, it was caught between the Japanese pursuit and a force coming from Hagiang and was obliged to capitulate. Almost all of those who attempted to conceal themselves among the calcarious crags were massacred before reaching China.

The group west of the Red River rendered the most coordinated resistance of the campaign.

Its nucleus was formed by the units stationed at Tong-Sontay near Hanoi, which succeeded in concealing themselves among the mountains separating the Black and Red rivers. There it was reinforced by a battalion from the Foreign Legion which had just been engaged in a pitched battle with the Japanese forces east of the Red River. Afterwards, all the forces west and south of Laokay as far as Vien-

tiane joined it. It comprised a total of 4,000 men including about 2,000 Europeans, of which 1,200 were soldiers of the Foreign Legion.

This group, although constantly in a very difficult situation, enjoyed a few favorable circumstances.

No Japanese were at its rear. It had regular organizations for supply and cover which permitted the use of its forces. Elements stationed at Chobo, reinforced by units from Lai Chau, gave access to a route parallel to the Black River. The Baxat and Phongtho units covered it in the direction of Laokay, which fell on 10 March. The Vientiane, Kieng-Khouang and Luang Prabang units slowed the northward advance of the Japanese coming from Siam and the Tranninh plateau.

Owing to the presence of the Foreign Legion units, it had a very large percentage of Europeans. As far as Dien Bien Phu, it possessed a highway and a few trucks.

By means of radio liaison with Calcutta, it obtained air support from the Allies as well as weapons and food, but no men. Likewise, a few air fields in the area permitted evacuation of its wounded.

Under the heavy pressure of the Japanese, the "Free Indo-China" sector was reduced gradually on every side. By the end of March and the beginning of April, Luang Prabang, Son la, Phongtho and Lai Chau fell. By April, the force was reduced to two small areas northwest of Laos. During the first part of May, those who remained were obliged to seek refuge with the Chinese Allies after having had more than seventy battles with the Japanese.

Thus, by July 1945, with the exception of the few remaining at large, all the Europeans of Indo-China were either dead, imprisoned or in exile.

Casualties in deaths amounted to 2,200 French, of which 1,800 were soldiers. Indo-Chinese dead included 1,300, of which 600 were soldiers. The French losses were seventeen per cent of the forces, and if the wounded are counted, the losses rise to a fourth of the officers and noncommissioned officers and a fifth of the men of the Indo-Chinese occupation forces.

The most fortunate of the captives were shut up in fortresses. The remainder received brutal treatment at the hands of Japanese police, and were subjected to work camps where suffering was severe. Hoa Bihn will go down in history alongside of Dachau and Büchenwald.

Military duty is a part of social duty; it is necessary, as Montesquieu said, that the Army be of the people and that it have the same spirit as the people.

Major General Pedro Sicco in *"Cior,"* Uruguay

Science and Strategy

Translated and digested by the MILITARY REVIEW from an article by Colonel José Hijar, General Staff Corps, in "Ejército" (Spain) August 1947.

General Concepts of Strategy

HERETOFORE the study of military subjects had been limited to matters closely related to the military establishments. Since World War I, however, such studies have tended to include political and economic matters as well, and in fact have embraced the study of the entire nation with its population, resources and productive capacity. This epoch, then, marked the beginning of total war. That is why so-called "modern strategy" comprises not only the land, sea and air forces of a nation, but its war potential as well.

We understand by "grand" or "general strategy" "the sum total of those principles and of those means with which to insure the permanence of a state or people." It is based on history, tactics and other sciences, including today economics, sociology, industrial technology, etc.

The factors that are included therein comprise three basic groups corresponding to the three forces of a state: military, political and economic; all properly integrated and coordinated.

The necessity of employing all the armed forces of a nation does not mean that they must be ready and available at all times. Hence there is the need of differentiating between the actual forces already constituted, that is, the regular army, the organized and trained reserves (with their equipment and fortifications) and the potential forces which comprise all other forces in the nation.

Here the problem is to be able to transform the latter into effective forces before the enemy has done so, enabling us to crush him before the conversion of his forces to a war footing is completed. Germany tried to accomplish this with her *blitz* methods during the late war. It must be realized that conversion of industries from peace to war will take from twelve to twenty months, as was the case with the United States, in World War I. No figures are available for the last conflict inasmuch as the United States was actually getting ready during the "lend-lease period," before war had been formally declared. It follows that the war potential of a nation is measured by its actual capacity for war as well as by the ease with which it can adapt itself to war conditions.

The problem of a sound war doctrine consists in harmonizing things spiritual and things material, without attempting to substitute one for the other. Given equal material power, victory will depend on the spiritual factors; and in an evaluation of the war potential of a nation it will be necessary, in considering the human factors, to consider the number and ability of its technicians.

Surprise constitutes a strategic principle, one that can be obtained through the sudden and unexpected employment of well known means or by the application of new and unsuspected means.

Science and Inventions

Science and research, both included among the economic factors we have mentioned, are particularly concerned with this latter method of obtaining surprise.

Each period in history has had its own civilization with its corresponding economic and social systems, and these in turn have determined the general structure of the armed forces.

There have been, throughout the course of history, fundamental inventions such as gunpowder, which changed the aspects of battles and affected tactics. Later, the developments in railways—following the invention of the steam engine—presented a new weapon to strategy. Then

there is the internal combustion engine, which has given added flexibility to military transportation and permitted the employment of such new weapons as airplanes and mechanized vehicles. Radio has extended the scope of command functions, and currently is a source of new inventions and developments. All have had their influence on tactics and strategy.

Each new invention is a novelty whose application cannot be exactly realized by all, since certain technical qualifications may be needed for its understanding, in addition to imagination. Occasionally, due to an excessive amount of imagination, too much is expected. At other times, not enough imagination may be responsible for a faulty or insufficient exploitation, thus permitting a surprised and confused enemy to react and get ready for future contingencies, thereby sacrificing the strategic advantages that could have been obtained. Instances of such lack of imagination occurred in 1915 at Ypres, where the Germans underestimated the possibilities of toxic gasses, and at the Somme in 1916, when, after the successful employment of tanks, the British advanced only eight kilometers, not having been ready to exploit their success. Much the same could be said of the German V-bomb during the last war, not enough of them having been manufactured to have had a decisive effect on the morale of the British people.

It must be realized also that men of practical mind generally resist new ideas and methods which are not born out of their own experience. The practical man tries to improve that which is defective or inadequate, but always does so along the lines of his own training and experience. Each new invention that alters the basic concepts is evaluated as a worthless product of the imagination. Yet we must realize that real progress is impossible without a scientific and orderly approach. Thus in 1914-18, the menace of German submarine warfare was met by the British Admiralty through the organization and employment of naval convoys. It was never foreseen that the solution to that problem could have been in ascertaining the exact position of the submarine. The results of sound ranging experiments were, at that time, not considered satisfactory.

Boards must be constituted, therefore, of both scientists and officers, so that the planners and those whose functions will be the employment of the new weapons are both present. Such boards must be charged with determining the needs of the armed forces, so as to solve their problems on a military basis, with scientific exactitute.

Organization of Science for War in Various Countries

During World War I, Germany was forced by blockade to charge her scientists with the problems of producing, by synthetic processes, the materials she needed for the prosecution of the war. Thus she was able to obtain nitrates for the manufacture of explosives from the air, since she could no longer get them from Chile, and gasoline through the hydrogenation of poor carbons, and rubber or "buna" from butadiene.

During the years between World Wars I and II, the Germans developed extensively, after painstaking research, our present day rocket projectiles and pilotless planes, and endeavored to perfect the tanks to meet the strategic concept of war entertained by the German General Staff of that time. This resulted in the production in World War II of the "Tiger" and "Panther" type of tanks, which were superior to the American and Russian tanks. For this purpose there existed at the German War Ministry a section charged with research and development for the army.

In England, the importance of science in war was realized after World War I, and various research agencies undertook

such studies, but without effecting close coordination with the military establishment they were to serve. It was World War II that forced the gradual improvement of the system, culminating in the establishment of the present section of Research and Inventions in the Ministry of Supplies which is without doubt the greatest scientific organization in Great Britain, employing some 4,500 scientists and engineers or from seven to eight per cent of the total number of scientists in that country.

This section includes three departments particularly concerned with defense, aviation and atomic energy, and handling matters previously handled separately in the Ministries of War and Air, the Admiralty, and the Department of Civil Aviation.

Heading the Department of Defense is the General Director of Scientific Investigators, with vast experience in investigations dating from World War I. This department was established in 1939, shortly after war was declared, and it is charged, among other things, with the study of new weapons and the development and possible use of new explosives and propellants.

The principal work in the Aviation Department comprises aerodynamics, mechanical structures, airplane engines, radio, etc. Under construction in Bedford is an establishment for aeronautical investigation that will cost twenty million pounds.

The Department of Atomic Energy has its experimental establishment in Harwell.

In addition to these departments there is a Directorate of Guided Projectiles, with its research center in Wescott, Buckinghamshire, with some of its installations presently under construction. Its director has been connected with rocket developments since 1936 and particularly during World War II. Under study is the possibility of establishing proving grounds in Australia.

Development of Various Significant Inventions

Let us now consider some of the most significant inventions of World War II. Let us see what prompted them, and how men of science on both sides have struggled to assure victory for their own forces.

Radar—Experiments on this subject were carried on during the years of peace between World Wars I and II in several of the countries that later became involved in the war. Great Britain, in particular, due to her island location, felt the need of protection against air raids in time of war, and of early detection of raiding planes, which her coastal observation towers were unable to accomplish in time to permit taking adequate antiaircraft measures. There are reports that the work really started in earnest in 1935 and was undertaken by the Radio Research Board with great secrecy. At the same time, similar studies were going on in the United States and in Germany and Japan.

British and American radar equipment, however, was far better than German and Japanese electronic equipment, being more dependable and of longer range.

The great secret of radar in detecting planes, however, was its ability to distinguish friend from foe, since mere detection meant little as long as fire had to be withheld until identification of planes by markings had been accomplished. This recognition was made possible by equipping friendly pursuit planes with a radio receiving and transmitting set which operated automatically both ways whenever radar waves were received, permitting the radar ground stations to receive proper identification signals in code from friendly planes. No signals were received back from enemy planes.

Radar also has been used to orient planes from the ground, to guide interceptors and bombers in their missions and

airborne troops to their landing areas. In the latter case there was dropped with the first paratroopers a small set capable of sending impulses to guide the rest of the air flotilla to a safe landing.

The British were finally able to develop from radar an apparatus which, while in flight, could reproduce for the bomber crew, even in darkness, the image of a city below.

So much for aviation. The British were likewise faced with the menace of German submarines, which were on the verge of spelling disaster for Allied maritime transportation. The battle of the Atlantic was on, and the submarines were well ahead.

As a countermeasure against submarines, naval convoys had been organized in World War I, inasmuch as the experiment with "sonar" were not yielding the desired results. The work along this line was not totally lost, however, since radar, together with the radio-sonde buoy—which was based on the principles of "sonar"—were finally able to neutralize the submarine. In this respect, it is interesting to note the statement made by Grand Admiral Doenitz to the effect that allied success in submarine warfare had not been due to superior tactics or strategy (where Germans were ahead) but to scientific know-how.

As radar equipment was being used by both sides, it was necessary to take measures against its use, and the Americans, in the spring of 1943, equipped some of their planes with apparatus for locating enemy radar installations on the island of Kiska in the Aleutians. They must have met with success there, since the method was again used to locate German radar installations in Sicily and Normandy.

The same year (1943) "carpet" equipment was used to "jam" German "radiosonde" equipment. The Germans then extended the range of frequencies of their detecting apparatus to permit working outside the "jammed" frequencies and the Americans countered with the system called "window," which released in the air thin metallic "ribbons" or "strips" which reflected false information back to the detecting stations. It is estimated these measures reduced the efficiency of German antiaircraft batteries by twenty-five per cent.

Rockets—Research and experiences in Germany on rockets date from 1936, when the British Intelligence Service learned about these experiments and found them of sufficient interest to initiate similar research in Great Britain.

We may catalogue them in two general classifications: rocket projectiles proper and long range projectiles, the latter being capable of further subdivision as aerial bombs—truly projectiles—and rocket planes, with or without a pilot.

Individual Arms—The "bazooka," developed by the Americans, was the first individual weapon to employ the rocket principle. Its need was felt in the Pacific to force the Japs out of their caves and shelters: however, their limited range and lack of precision made them ill adapted for that purpose. They were employed against tanks, having an effective range of fifty meters, and being capable of piercing 20-mm of armor. The Russians also used them. Toward the end of the war, the Germans had to devise a means of warding off the avalanche of Russian tanks being used against them; and since their factories were crippled by enemy aerial raids and were not capable of producing the needed antitank guns, they resorted to weapons of this type, developing the *panzerfaust*, an effective antitank weapon whose projectiles, with a hollow charge, is capable of generating 3,000° of heat on explosion and perforating a 20-cm armor plate. It was followed in turn by development of the *panzerschreck* and the *pueppchen*, the latter with

a range of over 200 meters, a veritable antitank gun.

Rockets Fill the Gap between Mortars and Artillery Guns

Various types of rocket projectiles were developed without marked success, since they all lacked sufficient velocity initially. They were mostly used against troops in the open.

The Russians used them mounted in batteries in what was known as "Stalin's pipe organ." Sixteen were fired simultaneously, covering at a distance of five km an area 900 by 450 meters. They were copied by the Germans and later by British and Americans in their landing craft during the invasion of Sicily and Normandy to build an effective fire barrier at the time of landing the troops.

Long-range Projectiles—The desire for increased destructive effect in artillery fire lead to developments in long range and large caliber weapons. Thus were developed the "Big Berthas" and 42-cm mortars of World War I and the large mortars used by the Germans against Sevastopol in World War II. These augmented calibers and increased ranges presented problems in manufacture created by the increased muzzle velocity and the difficulty of preserving the stability of the projectile in flight. The "life" of the piece would be thus sacrificed to increased ranges, and the projectile would be too complicated to resist the stresses and strains to which it would be subjected. Solution, then, was not to be found along traditional lines of development. A new approach was necessary to solve the problem and the answer was found in rocket propulsion.

The "V-1" bomb is in effect a small plane guided by gyroscopes, auxiliary motors and a magnetic compass. It had a maximum range of about 210 kilometers and a speed in flight of 500 kilometers per hour.

Neither Great Britain nor the United States had experimented with this type of projectile, but on their being used, the Americans began to work from V-1 fragments picked up in England. As their speed was not great, they could be dealt with by antiaircraft artillery and RAF pursuit planes.

It was then decided by the Germans to make a real projectile out of the "V-1," and the "V-2" was developed. This bomb carried its propellant in the form of alcohol and liquid oxygen. It was far superior to the "V-1," had a range of 300 kilometers and a velocity of 3,000 kilometers per hour, and could be guided by radio beams directed from the vicinity of its launching site. Neither antiaircraft artillery nor enemy aviation could cope with this type of bomb, its speed being greater than that of sound. They were not used until 8 November 1944, too late to achieve the desired results over England, since by that time the allied armies had already landed in Europe, and the RAF which had been notified about this new weapon had done a great job of destroying launching sites and production and experimental plants, including those at Peenemünde.

The Atomic Bomb—The tremendous military advantages that accrued from possessing such a bomb resulted from a fortunate combination of good luck, good management and colossal effort. We can cite, as background to this invention, the investigations on radioactivity conducted since 1902 by the Englishman Ernest Rutherford, who in 1919 discovered that by bombarding certain elements such as nitrogen with alpha rays certain atomic changes were produced. But it was really Fermi, a professor at the University of Rome, who conceived the idea that a heavy atomic nucleus, like that of uranium, could change into more stable forms when bombarded with neutrons, releasing in so doing tremendous energy. Exiled from his country, Fermi continued his work in Columbia University.

The Germans, Hahn and Strassmann, both disciples of Bohr, proved in 1939 that by such processes barium and lanthamum could be obtained, and this was communicated to professor Bohr who continued his experiments in the United States.

The Germans had installed in Norway a large plant for the production of "heavy water," which contains "deuterium"—an isotope of hydrogen needed as a "moderator" in nuclear reaction when uranium is bombarded with neutrons. British Intelligence found out about this plant and soon thereafter two separate "commando" raids neutralized the installation.

In the United States, an organization known as "Manhattan District" was formed. It was headed by Dr. Vannevar Bush, who until then had been head of the Office of Scientific Research, and included various men of science. Both Presidents Roosevelt and Truman gave impetus to the project and followed the development closely.

By 1943, construction of an atomic bomb was undertaken through two separate establishments; one in Clinton, Tennessee, where the isotope, "uranium 235," was produced, and another in Hanford, Washington, for the production of plutonium. Actual work on the bomb itself was initiated in November, and by July 1945 the first bomb was experimentally exploded in a desert region in New Mexico.

From what has been outlined above it is felt that the ever-increasing importance of science in the realms of strategy has been proved.

It has been brought home to me, not only in this campaign but throughout the war, that the soldier on the battle front, and the worker on the home front are closely linked members of the same team—neither can achieve any success without the other, both have to stand firm under fire and both have to see that their job is carried out in spite of all the enemy can do.

Field Marshal Viscount Bernard L. Montgomery

Italian Aviation in World War II

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AN examination of the contribution of Italian aviation in World War II in comparison with the enormous price paid by the armed forces, particularly the Air Forces of Fascist Italy, leaves one with much disillusionment. The disappointment would be more easily borne if Italian aviation had at least represented an important, though not perhaps a decisive, factor in the conduct of the war. Its failure appears to have been due, principally, to the dispersion of the forces already in existence at the beginning of the war. This, however, is not the sole reason, since Italian aviation fought for three years, from 11 June 1940 to 8 September 1943, as an independent air force and at the beginning of the war had at its disposal 3,750 planes. The production of the Italian air industry, which occupied nearly 100,000 persons, averaged 225 planes monthly. Altogether, during World War II there were placed at the disposal of the Italian Military Air Force, by the Italian aviation industry and by Germany, 7,800 planes, of which 6,500 were lost.

When the Supreme Italian Command found itself faced with the task of defending the empire with the air forces at its disposal, and with, in addition to this, the task of making air attacks, it quickly learned that an air force regarded as powerful in time of peace is rapidly consumed in time of war, and quickly loses its fighting ability if there are insufficient replacements. In spite of the fact that Italian aviation accomplished several brilliant feats in its initial operations, it was not able to exercise any appreciable influence on the course of the war.

When Italy entered the war, it was believed that the air arm would be able to meet completely all demands made on it. There was no lack of faith in its future. Italy's military aviation had been built up in nearly twenty years of indefatigable labor and its successes in the Spanish war and in Abyssinia had recently confirmed this opinion. A few days of action, however, sufficed to inspire serious doubts relative to its power.

The first personal lesson learned by the author, a pilot in an Italian fighter formation, was that the thing which is of greatest importance in the conduct of war is "mass"—mass in every sense, personnel, weapons and equipment—and that this ready and waiting mass was absolutely lacking in Italian aviation. The formation in question possessed sixty-seven Macchi 200's, the most modern type of fighter that Italian industry was able to furnish at that time. Its first employment against the enemy, with twenty-four planes, resulted in four lost, three planes badly damaged, six slightly damaged and two planes whose motors had to be changed.

Of the initial twenty-four first line planes, there remained, therefore, but nine for the next mission. However, twenty-four more of the original sixty-seven planes were sent against the enemy on the following day. One of these crashed on the take off. Of the remaining twenty-three, two were shot down, and one badly and another slightly damaged. Four of the others were obliged to change motors. On the third day, the formation went into action again, but with only eighteen planes, and of these, one was shot down, one forced to make a landing because of a damaged motor and three were damaged. The balance on the third evening was: fifteen planes lost, fourteen undergoing repairs and, of the personnel, seven dead and two wounded. On the fourth day, of the sixty-

seven initial planes, there were left but thirty-eight ready for service.

During the following two weeks, sixteen more were lost, six of them being sent to the factory. Thus after seventeen days of fighting there were left but thirty-six planes, of which twelve were undergoing repairs, leaving only twenty-four planes available. While on the first day there were twenty-four first line and forty-three reserve planes, on the seventeenth day there were no reserves.

The enemy used mainly Hurricanes and Gloster Gladiators. Our Macchis were the equal of the Hurricanes as regards speed, but inferior in climbing ability. As a result, the adversary always succeeded in gaining a greater altitude and getting into a position from which he could inflict heavy losses on our formation. Moreover, it could be seen that the British pilots, who had already gained combat experience against the Germans, were superior even to the best Italian pilots who were veterans of the Spanish war. In comparison with the Gladiators, the Macchi appeared to be superior, and the Italians were able to register a few victories over their enemy's planes. But even in these cases, from a certain point of view, the technique of the Gladiator pilots was better in spite of the fact that the difference in speeds was 100 km/hr. If one of the fast Italian planes rushed at a Gladiator from a position far above it, the latter, before the other could get within firing range, executed an "Immelmann turn" and disappeared out of the attacker's gun sights only to be over his back shortly afterwards.

Twenty days after the beginning of the war, the fighter formation received its first replacement of fifteen planes. But thirty-one of our planes had been lost or were undergoing repairs in the factory. Therefore, missions were undertaken with smaller formations. This resulted in air inferiority, since the enemy appeared, as at first, with formations of from twenty to twenty-four planes. He evidently had greater reserves at his disposal, and his losses were also less severe—about seventy-five per cent of those of the Italians.

The losses of other Italian fighter formations were similar to our own, and the reserves had been so heavily drawn on that they could not be replaced by current industrial production. In a few months, Italy was obliged to turn to Germany for equipment.

Already, during 1941, this assistance ceased to be sufficient, and the German command was obliged to transfer large German air formations to Italy. During the German campaign in North Africa, the Italian air arm was reduced to a situation where it formed only a subsidiary organization, subordinate to the Germans.

Italian aviation was unable to obtain air supremacy even in the first phase of the war, not only on secondary fronts but in the Mediterranean, in spite of having, as adversaries, only the Greeks (with an inadequate air force) and the English who in the beginning had only a small colonial air force.

The 700 odd planes, mainly Ju-87s placed by Germany at the disposal of Italy, sufficed only for the most pressing needs. By the second half of 1942, and to a greater extent in 1943, acts of sabotage against the government were being felt by the Italian Air Force. Its fighting ability steadily diminished, and in the summer of 1943, it had dropped to an almost catastrophic point. From then on, the Italian Air Force represented not an aid, but a burden to Germany.

With the armistice on 8 September, the Air Force was divided into two parts. Some 400 planes, of all types, some of them damaged, were able to escape to territory occupied by the Anglo-American Allies. A like number fell into the hands of the Germans. The remainder were destroyed by bombing attacks. There re-

sulted, thus, two bodies of Italian aviation fighting one another.

The portion which went over to the Allied side obtained, in addition to the remaining Italian planes, a quota of American P-39 Aircobra fighters and a few British Baltimore bombers.

The Republican Fascist aviation, with its Macchi fighters and Savoia S-79 torpedo planes, was absorbed by the German portion. Transport planes were transferred to Germany to fill the gaps resulting from heavy losses on the Eastern front. The Republican aviators came back, however, shortly afterward, provided with Me-109 fighters, and the Italian planes disappeared. The last Macchi 205s were destroyed at Udine in the autumn of 1944.

Italian Air Forces fighting with the Allies from their operation base in southern Italy, had an average of 420 planes at their disposal. From 8 September 1943 to 30 April 1945, they made the following contribution to the Allied effort: 4,221 flights at the front, 6,400 other flights; 23,465 hours of flying completed; 1,917 tons of bombs dropped; 500,000 rounds fired with planes' weapons, and 1,706 tons of cargo transported. In addition, 9,500 flights with transportation of 2,406 tons were made in the interests of partisans of Upper Italy and Yugoslavia.

The Fascist aviation in northern Italy with the Germans formed a few fighter and torpedo plane squadrons. It brought down around 100 enemy planes and sank ten ships. In the spring of 1945, there were but two fighter formations left with about thirty Me-109 planes and one formation with about thirty torpedo planes. German aviation in Italy possessed but one reconnaissance formation with Me-109s and Fw-190s, and one group of thirty Ju-188s. When the Americans crossed the Po, on 25 April 1945, the American fighter-bombers destroyed nearly all the Fascist and German planes still in existence in Italy.

Control of the air is the first requirement of war, the preliminary to freedom of action for all forces, land, sea and air. It is attained by progressive destruction of the enemy's air force in the air, on the ground, and in the factories. It proceeds simultaneously with the independent strategic mission, the long range air offensive against the enemy's war production and morale for the purpose of breaking his will to resist by paralysis of his means. It proceeds with the support mission, which is to isolate the surface battlefield and prepare the way for the troops advancing to the final battle and victory. Success in both these air missions is contingent upon control of the air.

General Carl Spaatz

Artillery Development in World War II

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AT the outbreak of hostilities in World War II, artillery had assumed a prominent place in the armies of the belligerent nations. It was divided, in all countries, into division, corps, and army artillery. In many instances, even so-called infantry artillery was found.

In Russia there were artillery regiments made up of light battalions equipped with 7.6-cm guns and 12.2-cm howitzers mixed, and 15-cm howitzer battalions. During the war, 15-cm artillery was shifted over to corps artillery for centralization of fire concentrations. As the number of guns increased, the strength of the division artillery was increased and the Russian division artillery appears to have consisted, toward the end of the war, of three 7.5-cm gun battalions and one 12.2-cm howitzer battalion. Aside from Japan, Russia was the only country which employed 7-cm artillery as the main piece in division artillery. This seemingly came about because of communication difficulties—deep snow in winter and marshy terrain in summer and autumn. Great numbers of fully modern 7.6-cm guns and 12.2-cm howitzers were used.

In Germany, all during the war, division artillery was made up of three 10.5-cm howitzer battalions and one 15-cm howitzer battalion. This organization had been fixed prior to hostilities, on the basis of very recent experiences.

In England, for a long time, the standard gun was of 8.7-cm caliber. Division artillery which appears to have constituted the main part of the artillery, consisted of a comparatively large number of battalions.

In the United States, the German organization of three 10.5-cm and one 15-cm howitzer battalions had been copied. After the war, however, the division artillery was increased in strength.

In Finland, the division artillery generally consisted of three or four battalions of 7.6-cm and 12.2-cm pieces. The ty of piece varied, however, depending on what was available.

Corps and Army Artillery

Corps and army artillery, on the other hand, did not have a fixed organization, but in most countries consisted of a number of independent battalions. The strength of corps artillery at first was, on the average, less than that of division artillery. As a rule, the battalions in each division could be reinforced by from one to three corps battalions in the main effort. But during the war, there was a tendency to increase the corps artillery to at least the number of battalions of the division artillery.

The heavy demands for fire support, both in the attack and the defense, required not only an increase in the total strength of the artillery, but also the organization into larger formation of powerful corps and army artillery. The Russians led in the organization of artillery brigades and divisions. In order to command and coordinate the great mass of artillery on a large front, it was necessary that corps and army artillery be organized into large permanent units. The Germans also began, in 1943, to organize artillery divisions, but for lack of guns of heavy caliber they were unable to carry through their plans.

After the war, the United States took up the idea of creating a few artillery divisions. The intention appears to have been to create one artillery division per army corps, and one per army. The division artillery, which was increased in strength to the equivalent of five battalions, now possesses six pieces per battery. There has, thereby, been created in

the United States Army, enormous artillery fire power resembling that of the Russians.

An idea of the importance assigned to artillery in various countries is provided by the so-called relative artillery strength of the division, or the ratio between the total number of pieces and the total number of infantry battalions. In the belligerent countries, this relative figure can be estimated to have been between eight and eighteen in which the lower figure refers to the smaller nations and the larger one to the larger powers. In the case of the higher figure, there are one-and-a-half artillery battalions for each infantry battalion.

In Finland, a very large artillery strength entered into her military organization in 1944.

Motorization

Motorization of both heavy and light artillery became general during World War II. It thereby received the same mobility as armored forces. Movement was made possible by cross-country vehicles, caterpiller mounts, and guns with self-propelled mounts. On central and western European battlefields, and in the African desert, motorized artillery came up to all requirements. But in Russia and Finland, long and snowy winters, marshy terrain in summer, and muddy roads in autumn, made heavy demands on mobility. In these countries, therefore, there was always a small proportion of horse-drawn light artillery. Even in Germany the light artillery was usually horse-drawn.

Tactics

During the five years of the war, it was repeatedly proved, in spite of support by aviation and armor, that no advance was possible and no attack could be warded off without strong artillery support. Even during winter operations, the Finns observed the difficulties of conducting an operation with little or no artillery support. The Finns were particularly weak in counterbattery fire. But after 1941, Finland was considerably better equipped in artillery with a larger number of units and more modern pieces. During the attack phase of her operations (1941-1942), strong artillery support was always provided the main effort, with as many as fourteen battalions for the support of a single division. When this could not be done, as a rule, no progress was made.

Massed Artillery

As the war progressed, massed artillery was employed more and more. The first great mass employment of artillery occurred in the Russian defense of Moscow in the winter of 1941. The concentration of artillery played a large part there, according to Russian reports, in stopping the German offensive. The Russians continued the mass employment of artillery, and by the end of the war it had become the rule in every major battle. In the "great offensive," there were artillery concentrations of as many as 500 pieces per kilometer of front on several occasions. The Russians called this the "artillery attack."

In defensive operations during the last year of the war, the Germans were unable to effect suitable artillery concentrations. Counterbattery fire and general counterfire activity had shown its capacity for preventing the execution of an intended attack. The great stretch of front that had to be defended could not be sufficiently manned. Unmanned portions were defended by artillery fire which was shifted from place to place. Thus, the general lack of manpower placed the burden of defense more and more on the artillery which was stated to have borne from sixty to eighty per cent of the burden of the battle on many occasions.

In the Finnish defense, artillery also played an important role. Under the terrific pressure created by the Russian sum-

mer offensive of 1944, the Finns were near collapse. The great fire power of artillery on many occasions determined the outcome in favor of the defenders.

The Russian method of the "artillery attack" was turned to profit by the western Allies. In Africa, Italy, and France, most of the major attacks were conducted with Russian type artillery concentrations. These battles showed what a relatively slight effect air bombing attacks had on the troops in defensive positions as compared with the effect produced by artillery assault fire. According to German officers, Cassino was a classical example of this fire.

Centralization and Decentralization

Two different methods of artillery direction came into use during the war, the one characterized by decentralization and the other by centralization. Often a combination of them was used.

During the Finnish winter campaign, the Finns employed artillery, as a rule, in the form of independent battalions which cooperated with certain infantry units. There were no regimental formations. The tactical command of artillery was exercised by artillery officers on the division or corps staffs. During the war of 1941-1944, the same principle was followed, although centralized direction also was used. Similar employment of division artillery was practiced by the United States. The Americans conducted operations with a semi-permanent combat group, consisting of one infantry regiment and one 10.5-cm battalion working together, the so-called "combat team." After the war, however, it was realized that this combat group arrangement did not always permit flexible adaptation of the artillery to different situations.

Centralized direction of artillery first came into use in the Russian armies and resulted from the very large number of units employed. Mass artillery effects cannot be imagined without centralized direction both in the tactical and technical sense. In the other belligerent countries also, this same conclusion was reached.

It can, therefore, be stated that where artillery possessed but little strength, decentralization prevailed, and independent battalions were the rule. As the artillery increased in strength, centralized direction was usually practiced. Combinations of these were also employed in which division artillery partly operated with independent battalions and corps artillery worked together with other formations in fire concentrations, as in the forces of the United States and Finland.

The artillery battalion has been the usual fire unit, although fire by batteries has occurred in certain situations.

The most characteristic method of attack during the latter half of World War II was a tremendous assault fire laid down by artillery. The method of procedure was often the following: With support, reinforcing, counterbattery artillery, and very long-range artillery, an assault fire was laid down simultaneously on the enemy's frontline combat forces, battery position areas, headquarters and maintenance areas, and communication lines. The assault fire covered a depth of three to five kilometers, as a rule, but at times was extended to eight kilometers. This fire was complemented by direct artillery fire in the front line. This fire included the areas far to the sides of the direction of main effort. Its duration varied, usually, between two and three hours, but sometimes as long as four hours. When the attack with tanks and infantry started, a fire-free passage was left through the assault fire. The attack was protected ahead and to the sides to prevent counterattack. When the attack reached considerable depth, it was followed by fire from long range artillery while the supporting artillery was rapidly moved ahead to join the advancing attack.

The entire attack was preceded by care-

ful, secret preparations to take advantage of surprise. Supporting forces and the artillery were usually not placed in position until the night before the attack. Before that, steps were taken to insure ammunition supply, targets were determined, measurements of the field made, etc.

The time for beginning the attack varied. The traditional time, at daybreak, continued to be the usual time, although night time was often employed.

Russian assault fire, together with a heavy attack, often caused up to sixty per cent losses in personnel. Enemy signal connections were badly damaged so that command was difficult or impossible. The subordinate artillery commanders were forced to fall back on their own individual tactical measures to prevent collapse. Both the Finns and the Germans attempted, therefore, to evacuate the front portion of a defense area when such an attack was expected.

Defense artillery did not open fire from regular battery positions until an actual attack occurred. Prior to this, deceptive measures were employed with fire from moving batteries. If, because of disrupted signal communications, fire and combat direction became impossible, assault fire in accordance with a fixed plan was laid down by automatic weapons. This was blind fire, but was employed in the hope of stopping the enemy.

At the beginning of the war, armored attacks were often carried out after only a brief period of assault fire, which was to be continued by the guns of the tanks. The lesser mobility of the artillery, as compared with that of the tanks, also influenced this method. Later, antitank measures and the increased mobility and range of artillery limited the mobility of armored formations, and toward the end of the war an armored attack was seldom carried out without powerful assault fire and continual artillery support.

Counterbattery fire proved very important in effective action. On the German side, it was believed at first that counterbattery fire could be replaced by air bombing attacks, but, due to the powerful Russian artillery, the conviction was gradually formed that this was erroneous.

On the basis of experience in defense fighting in the east during the last year of the war, the following uses of artillery fire are listed in the order of their importance: (1) counterbattery fire, (2) counterpreparation, (3) defense fire ahead of and in the main position.

Assault batteries were mainly employed as accompanying artillery in attacks to crush more stubborn resistance and minor fortifications, as a supporting weapon in delaying action, and as mobile antitank defense.

Technical Developments

The conventional artillery piece has continued to be developed as the most important of all gun types. Developments just prior to and during the war consisted of a general increase in calibers to obtain greater effect from individual shots, and an effort to increase ranges. While a range of ten kilometers was considered satisfactory at first, this distance became the minimum permissible while the upper limit increased to thirty kilometers, even for field artillery. In division artillery, calibers now varied between 7.6 and 15-cm, while corps artillery usually included guns between 10.5 and 24.0 calibers. The 15-cm caliber gun proved an especially effective piece in most situations. For counterbattery fire or fire against communication lines, guns of from 14 to 17-cm caliber and larger came to be used, and these possessed ranges of between twenty and thirty kilometers.

A mount of an entirely new type was general in the armies of the great powers, the self-propelled mount with caterpillar tread. Assault artillery guns, which had already been introduced by the Germans, were regarded as an improved type of

conventional artillery, but they were assigned different missions. Only toward the end of the war was the idea fully worked out, and artillery pieces with self-propelled mounts and without actual armor protection were made for normal support missions. First, the Americans made use of this principle and engaged a number of formations with self-propelled guns in France in 1944. The piece is, therefore, an ordinary gun, and is not to be confused either with assault artillery or tanks. After the war this type of artillery was increased in the United States, and its exclusive adoption was considered. The advantage of this type of piece is its readiness for fire. The disadvantages are great weight and difficulty of concealment. For the conditions in Sweden, possibly our 10.5 and 15.0-cm piece would be suitable for self-propelled mounts.

Assault artillery pieces at first consisted of 7.5-cm guns, but during the course of the war the caliber was increased to 10.5 and 15.0-cm. They were provided with thick armor in front and were found mostly in the Russian and German armies.

Another type of gun developed during the war was the salvo gun employing short-range rockets. Originally, these were intended as a substitute for the ordinary artillery pieces. They were employed first by the Germans, afterwards by the Russians, and later by the Americans. The most characteristic features of the piece are its astounding fire power and relatively light weight. But its disadvantages are many: short range, length of time required for cooling off and reloading, great dispersion, and difficulties of concealment.

Recoilless guns have not been generally employed as artillery pieces. In the Finnish winter war, the Russians employed a 7.0-cm gun of this type, but it appears not to have been effective, and after the war was no longer heard of. In the United States toward the end of the war, 7.5 and 10.5-cm pieces intended for airborne troops were produced.

Combat at a distance against an adversary in depth led to new methods for increasing the range of artillery, but at the end of the war these methods were still experimental. The first in this field appears to have been the Germans, who seem to have worked along three different lines: "over-caliber" guns, guns with tapered barrels, and rocket projectiles.

Auxiliary Technical Means

Fire direction with the artillery liaison plane was an indispensable auxiliary, not only for counterbattery and harassing fire, but also for the ordinary support mission. The Germans employed a liaison plane, but they believed they could neutralize enemy artillery by aerial bombardment.

There were two forms of artillery liaison plane, a small two-seated slow flying plane of the sport type, and a fast reconnaissance plane. The slow type, which was the most common, was employed by division and corps artillery for ranges up to about fifteen kilometers. But in the case of fire direction at ranges of fifteen to thirty kilometers, the slow planes were unsatisfactory, and in such cases a fast plane was used which could fly over the enemy area at higher altitude. High speed, however, interfered considerable with satisfactory observation.

The artillery liaison plane now belongs organically to both American and British artillery.

Another auxiliary, the radio fuze, was of great importance in air defense and with field artillery. In stopping the German Ardennes offensive in December 1944, it appears to have been used for the first time, and contributed much to the favorable outcome of the defensive battle. The radio fuze may replace the field artillery time fuze for obtaining air-bursts, and

when functioning properly it gives much better results.

The first advantage of this fuze is that the burst always occurs at the same height regardless of declivities or unevenness. The greatest disadvantage of the radio fuze appears to be that a fairly large per cent of the bursts occur during flight due to terrain masks and the proximity of other projectiles when massed fire is employed.

Radar can also be employed for reconnaissance, and for fire direction in ground combat. This occurred on the Allied side in the final phase of the war, and the methods of employment were still experimental. During the past two years, methods have certainly been perfected in the armies of the great powers. Two different methods were employed, namely, measurement of projectile paths in order to locate enemy mortar and battery positions, and measurement of the usual ground targets such as vehicle columns, troop concentrations, etc.

The signal service certainly underwent great development in equipment. Radio equipment led. Improved operation, greater range, lighter apparatus, etc., resulted. It is likely that the radio equipment of the larger powers is several years ahead of Sweden's in technical development.

Opinions differ as to the relative practicability of wire and radio liaison for artillery. The experiences of war show that the side which happens to be superior gets more satisfaction with wire connections, while the inferior side finds its wire connections are more often broken, and radio then constitutes the only possibility. Paradoxically, this indicates wire combined with radio is best in attack, while radio is the only means of liaison that can be depended on in defense.

Long-Range Rockets

Long-range rockets are another of World War II's most epoch-making developments.

The German V-1 was a flying projectile with reaction propulsion, and the V-2 a liquid fuel rocket of large size. The greater possibilities of development seem to lie on the side of the V-2 which, even in its initial form, was an effective long-range weapon against which no counter means could be employed.

According to American reports, the Germans had a hundred different types of guided rockets in process of development at the close of the war. These, together with the V-2, are being further developed in other countries and the United States.

Medium range rockets should become important against enemy battery positions, communication lines, and assembly areas, in the same manner as long-range artillery. Possibly like ranges may be attained with conventional artillery. Such rockets could even be used as coast artillery, or on war vessels.

Long-distance rockets will likely come to be the principal means employed in attacks on enemy cities. If, in addition, atomic explosives, gas, poisons or bacteria are used as a charge, the most frightful means of destruction ever created would become a reality.

One fact which cannot be ignored is that the importance of aviation will likely decrease as a result of the advent of this artillery weapon.

Conclusions

The most important observations on World War II, and the principal innovations, may be summed up as follows:

1. "Conventional" artillery was modernized by the introduction of self-propelled caterpillar mounts and increased ranges, and was the most important fire support weapon.

2. The radio fuze considerably increased the ability of the artillery to obtain airbursts.

3. The artillery liaison plane showed itself to be valuable in fire direction.

4. It was possible to employ radar for

ground reconnaissance and target location.

5. Short distance rockets proved a good complement to the artillery in both attack and defense.

6. Mass employment of artillery was the rule in all major battles. This is, perhaps, the most valuable lesson.

7. A few revolutionary gun designs for great increase in range appeared, but were as yet in the experimental stage.

8. The long-range rocket artillery should, in the future, undergo marked development.

The latter weapon could lead to the division of artillery into two main categories: (a) Support artillery (division, corps), (b) Long-range artillery.

The support artillery should, then, consist of conventional pieces, together with, among other things, the above innovations and auxiliaries. Long-range artillery should consist of mobile rocket artillery for tactical purposes, with ranges of some fifty kilometers, together with rocket artillery of the V-2 type for strategic missions, with ranges of several hundred kilometers.

Evaluation of Information

Translated and digested by the MILITARY REVIEW from an article by Colonel D. Perret in "Allgemeine Schweizerische Militärzeitung" (Switzerland) July 1947.

REGARDLESS of his grade, it is one of the chief duties of the intelligence officer to judge correctly and speedily all information received by him.

In the final analysis, the correct evaluation of information determines how the next plan for obtaining information will be constituted; how the means for obtaining and transmitting information will be employed; how the information will be distributed to all interested personnel; how the situation will be judged by the intelligence officer, who will always be within reach of his commander; and lastly, how the fighting forces will be employed.

This article will explain a method by which the unit intelligence officer can properly judge information. This method should lighten his difficult task. It is based on information gathered during recent years in many exercises in courses for intelligence officers and adjutants.

Classification

It is well to classify information immediately on receipt in one of the following categories:

(a) Reliable, important and immediately usable information.

(b) Reliable information, but of no immediate importance.

(c) Questionable information which would be of importance if confirmed, and therefore to be checked immediately.

(d) Questionable, and not of immediate importance.

(e) Information which, under existing circumstances, appears improbable.

In each of these categories, information may be found that will either confirm or refute some earlier report. Consequently, such information will alter previous classifications. Other information may justify immediate measures, for example, advising a neighboring or subordinate commander.

When initial classification has been made, the intelligence officer then has to decide to whom the information is important. Information which appears improbable or questionable will assume an entirely different appearance as soon as it reaches a neighboring or subordinate

formation. Hence, in each instance, one must decide:

1. Whether it is to be transmitted immediately as a single piece of information or;

2. Whether one may wait and make it known later in a report or bulletin.

In the first case, the intelligence officer still has to decide what means of communication he will use in getting the information to the interested persons. Because of the consequences that may follow the transmission of this information, the intelligence officer himself must make this decision. Immediate transmission of information must, however, be the exception, a thing that is still frequently forgotten in peacetime maneuvers. Transmission lines are always barred at certain times. That is to say, there are times when it is impossible to transmit other kinds of information. Though this is of no great importance in peacetime exercises, such a situation can have serious consequences in time of war. In this connection, it is well to bear in mind that in time of war the majority of mistakes made by the intelligence service are paid for by increased bloodshed. This is one more reason for the command's giving increased attention to the selection and training of intelligence personnel.

Although it is well to post immediately all information received in the information journal, and enter it on the situation map, it would be a mistake to consider that this work is of chief concern. This can always be done later and should by no means cause a delay in the decision of the intelligence officer as to how he is to divide and distribute the information.

If the intelligence officer is sure of his mission, and particularly if he possesses a good general picture of the situation, he will be able to decide quickly into what category each piece of information should be placed. This is most simply done by marking each piece of information, for example. with one of the letters a, b, c, d, or e, corresponding to the above-described categories, followed by the numerals 1 or 2, depending on whether it is to be transmitted immediately or later. In case 1, he should also indicate what means of transmission is to be employed and who the recipient is to be. Other methods of classification may also be employed, providing they are logical.

In a well organized command post, the intelligence officer will have chosen and trained a capable subordinate or noncommissioned officer who helps him with this work and who is able, in case of necessity, to carry on alone.

Factors in Evaluation

It is not only the contents of a piece of information that determines what must be done with it, but also its origin or dispatching agent; its age (date and time it was dispatched); the tactical circumstances under which it was dispatched; its value and importance with regard to the tactical, technical, material or morale aspects.

Let us briefly glance at these various factors. The contents of a piece of information is, of course, the principal factor. If it is complete and answers all the classical questions: where, when, who, what, and how, its value is at a maximum. The source of a piece of information is of more or less importance according to the personality, military rank, tactical situation, and standing of the sender. If the sender has the reputation of being a cool-headed, reflective man whose nerves never get the better of him, then everything coming from him will be of a different significance than if the sender were an excitable or hot-headed individual. The age of a piece of information is often just as important as its contents. If it is too old, even though it be corroborated, its contents even though pertinent, may be quite devoid of importance. For this reason it must always be required that all reports show the time of their dispatch. If their age cannot be ascertained in this way,

one must endeavor to reconstruct the method of transmission, origin and tactical setting. On arrival of a report which is incomplete, date and time of dispatch are to be entered, accompanied by a question mark. By "setting" I mean the tactical situation under which the information was given. In order to know and correctly judge this setting, the intelligence officer must possess a general picture of the situation.

The value of a piece of information judged on the basis of what one already knows is an evaluation factor of a more personal character. This value is determined by the picture the intelligence officer has of the situation of his own and the enemy's forces. The greatest danger in the evaluation of information is "to believe in the thing that corresponds to our wishes" or to believe in our hope. Here the importance of critical evaluation by the intelligence officer is most obvious.

Every piece of information, depending on its content, is of greatest importance in one of three fields: tactical, technical, or morale. For example, one piece of information will bring to us something new concerning the situation of a certain unit, the progress of the battle it is conducting, the enemy facing it, the fire it is being subjected to and the resistance of the enemy. Another, on the other hand, will bring us information relative to new combat means in the hands of the enemy or peculiarities of the ammunition being used by him. Lastly, the information may contain data relative to the morale condition of one's forces, their behavior under the fire of the enemy, their will to resist, or the influence on them of their commander or leaders.

Conclusion

The net result of the foregoing is the evaluation of the situation that a good intelligence officer should be able at any time to give his commander.

This evaluation is the result of a series of deliberations based on facts, possibilities and probabilities. The evaluation of a situation, however, is subjective to a certain extent, since it is based not only on a given tactical situation, but also on certain aims. The situation is judged under certain influences which cannot be mentally dismissed: the tactical situation of the moment and the combat objective.

In the troop unit, the intelligence officer can, as a rule, organize his evaluation according to the following plan:

1. His own and neighboring units: Mission, disposition, echelon, existing liaison and morale and material conditions.
2. The enemy:
   (a) Where is he?
   (b) When was he at some one, or several places?
   (c) What sort of enemy is he? Kinds of troops and weapons, strength, activity (especially the type of his artillery and its targets)?
   (d) What are his possibilities from the standpoint of his means, his conduct, usual deportment and nature of the terrain.
   (e) What would be the worst disaster for our own forces?
3. Probabilities—a number of suppositions from which is deduced the case that is most likely.
4. Conclusion: What we must expect.

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Fourteenth Army Administrative Problems—After Imphal

Digested by the MILITARY REVIEW from an article by Major General A. H. J. Snelling in "The Army Quarterly" (Great Britain) April 1947.

IN July, 1944, the battle of the Imphal Plain was over. The Japanese Army had suffered the greatest defeat in its history and was in full retreat. The Japanese High Command still looked on rivers as effective barriers. They were soon to be taught how mistaken they were. This in spite of the almost complete absence of bridging equipment such as the Rhine knew, and the fact that most of the little equipment the army possessed had "perished" owing to the climates and storages which it had suffered in its long journey on its way to Burma.

The Army Commander realized that the decisive battle for Burma had been won, and that the enemy must be given no time to recover. Equally spectacular defeats and even harder fighting were to follow, but the Japanese myth of invincibility had been destroyed, to be replaced in the Fourteenth Army by complete confidence. And so the order was to allow the Jap no respite, but to follow him up at once.

Administratively, this was apparently out of the question. The monsoon was then at its height. The only routes—there were no roads at all—to the Chindwin lay either through Tamu and thence by the malaria infested Kabaw Valley, or over the almost impassable track across 6,000-ft. hills *via* Tiddim. On the Imphal Plain itself there were at that time far more troops than the attenuated lines of communication could support. The motor transport that should have been on the Imphal road was not only inadequate but it was not there, as having been sent on other vital tasks further back, it could not be collected immediately. Stocks of everything on the Imphal Plain had been necessarily "eaten down" and the stocks for the base at Manipur Road were scattered between the permanent and the temporary bases. The transport aircraft had done a magnificent job, but crews required a rest and engines had to be overhauled. According to administrative precepts, the Army must halt to refit in every sense of the word and send back about half its strength to India to reduce the tremendous strain on the lines of communication.

However, the Army Commander, and every single officer and man under him, had very different ideas. The pursuit of the Japs was everyone's thought, short rations and all else was only a minor matter—in any case the administrative staff at all levels "would arrange."

From July onwards all efforts were turned to the re-stocking of depots of all kinds on the Imphal Plain. The Army Staff was faced not only with the problem of finding large reserves to meet future plans, but also with meeting the immediate and heavy requirements of the formations which were now re-equipping. Meanwhile, the active pursuit of the Jap was in full swing.

On the east, the 11th East African Division was forcing its way down the Kabaw Valley meeting appalling conditions of torrential monsoon rain and consequent mud and swamps. There was, of course, merely a mud path running through the thick jungle. The physical feat, apart from enemy action, of getting to Kalemyo and blazing a better trail for the troops and lines of communication transport that were to follow, in better weather, was one much greater than has been done by any troops in any former war. Guns, trucks, jeeps and everything on wheels literally had to be dragged for miles through deep mud. Vehicle engines in most places were worse than useless and merely served to "dig in" the wheels. It is doubtful whether any other troops, British or Indian, would have had the

physical endurance to have completed the task. But even the Africans could not have carried it out had it not been for DDT, mainly sprayed from the air. Here, in one of the worst malaria infested areas in the world and at the height of the malaria season, the incidence never rose as high as four in a thousand per day. In the earliest stages, this division was fed by road, but mud soon rendered this impossible and full air maintenance had to be undertaken.

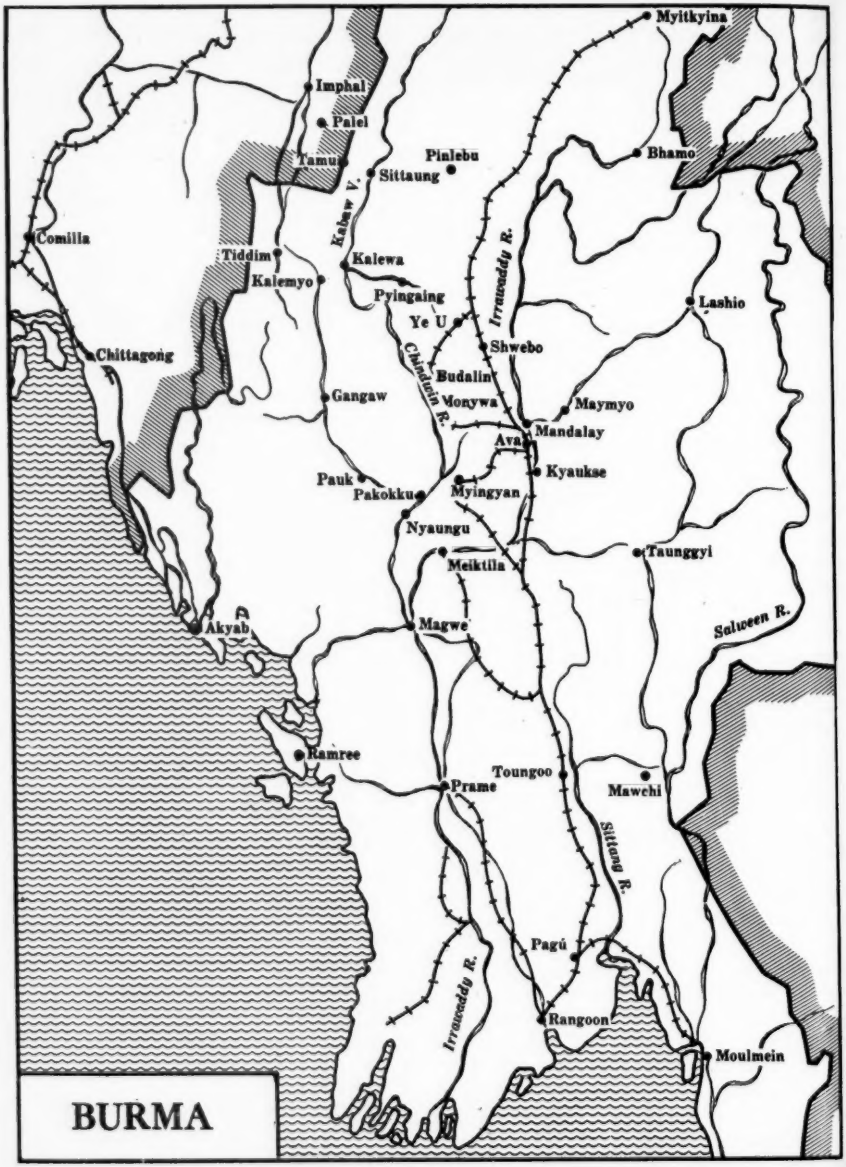
In the center, the 5th Indian Division was forcing its way through the hills to Tiddim and on through the densely wooded mountains to Kalemyo and to Kalewa. Before the Jap attack there had been a road from Imphal to just beyond Tiddim. It was hoped to use this so that the Division could be fed by land. It was soon evident that the lack of road maintenance and the destruction done by the Jap involved repairs that were quite beyond the capacity of the limited number of engineer and pioneer troops in the Army. In any case, the work would be of no permanent value as it would be abandoned after the Division had reached Kalemyo. So this formation also came on to supply by air at an early stage.

On the right of the 5th Indian Division, operations were undertaken by the Lushai Brigade. This formation did not even have a mule track to follow in its operations over, around and through some 200 miles of unexplored mountain jungle. It was therefore necessarily on air supply throughout. Often the appalling weather over the hills prevented the air drop in spite of the skill and daring of the aircraft pilots, and as the troops could carry nothing they had to go hungry on many days. In addition, there could be little or no evacuation of wounded or sick, as in most places there was not enough flat space even for the light American L-5 aircraft.

Perhaps the biggest administrative problem the Army had to face throughout the campaign was that of priorities. First, there was the question of what was to come to the Army Depots from India over the long lines of communication by road, river, sea and to a small extent by air, the overall capacity of which was so limited. Requirements were unlimited, but the movement capacity was limited, so it often seemed, to vanishing point. The Army's allotted lift over the railway had to be co-related to the American needs for North Burma and for China. Further, the stores required for the troops, some carrying the highest priority, were not all available in India—this made an "unknown quantity" as far as the Fourteenth Army Staff was concerned. Monthly priority meetings with representatives from General Headquarters, India, American Headquarters, Movements, Railway Companies and all concerned were instituted first in Calcutta and later in Delhi. Not only were stores involved, but movements of troops in complete formations with all heavy and light equipment, reinforcements, leave parties and so on. The monthly conference settled matters on broad lines, but the messages arising from urgent demands, last minute requirements and then "non-availabilities" put a tremendous strain on Signals.

Air Supply

Within the Army there was the additional factor of the air lift, always varying but never enough for troops completely dependent on air supply. Here the priority problem was even more vital. "Guns or butter" was a matter of intense consideration. Food must go in, but was ammunition so vital that the ration must be cut? This was a difficult decision in the earlier days when it was realized that ration cuts would have to be made later, and so were to be avoided until a real emergency arose. Were men more necessary than anything? If so, were they to be in complete units? Were ordinary reinforcements or were returning leave personnel complete with their due proportion of noncommissioned officers required?


Myitkyina
Imphal
Palel
Tamu
Pinlebu
Sittaung
Bhamo
Kabaw V.
Irrawaddy R.
Comilla
Tiddim
Kalemyo
Kalewa
Pyingaing
Ye U
Lashio
Chittagong
Shwebo
Chindwin R.
Budalin
Gangaw
Monywa
Maymyo
Mandalay
Ava
Kyaukse
Pauk
Pakokku
Myingyan
Nyaungu
Taunggyi
Meiktila
Akyab
Magwe
Salween R.
Ramree
Toungoo
Prame
Mawchi
Sittang R.
Pagú
Irrawaddy R.
Rangoon
Moulmein
BURMA

Troops, particularly after Imphal, often of necessity spent up to as much as six months in the Army's reinforcement or reception camps waiting for air transport. This was very aggravating for the personnel themselves and thoroughly bad for them, but even more exasperating to the commanders who wanted the men so badly in the forward units. Canteen stores, urgent though they were, necessarily suffered first cuts when such were essential. If a small lift were available for canteens, which was the better morale raiser: beer (infernally heavy stuff) or notepaper? It may sound strange now, but often a matter of this kind was of such immediate importance that a Corps or the Army Commander would have to be asked for a decision.

Each Corps submitted a weekly priority list (with frequent amendments) to Army Headquarters, which latter added the requirements of the various detached forces. A conference at Army Headquarters and sometimes at Corps, decided railroad/air allotment. The bottom half of the Corps lists often could not even be discussed. The agreed demands were then handed to the services and the transportation agencies. Suddenly fighting would flare up on XXXIII Corps front and extra "absolute essentials" were needed at once. Was IV or XV Corps to be cut, or were they to share the cut? Or could Engineer or Signal stores be cut? From Imphal to Rangoon, daily decisions were required from harassed staffs of all formations who were confidently expected to produce miracles—and did.

While Headquarters Fourteenth Army was at Comilla and the Air Transport Command Headquarters (British and American) was also there it was possible for Army Headquarters to allot and place demands for the air lift. As the numbers of available serviceable aircraft altered daily, and continuous liaison was essential, it became obvious that when Army Headquarters moved forward, which Air Transport Command could not do, some alternative would be required. The Army Air Transport Organization (AATO) therefore came into being, with Headquarters alongside the Air Transport Command, and with representatives of Army Headquarters at the more important airfields and with the Air Supply Companies. After inevitable early troubles the organization worked very satisfactorily. It was a most exacting and aggravating task requiring always the utmost tact from the Army and Air officers who comprised it.

New Directive

By August 1944, the 5th Indian and the 11th East African Divisions and the Lushai Brigade were going ahead well; the end of the monsoon would find part of the Army on the Chindwin and even across it. A planning directive had been received from Headquarters, Eleventh Army Group, so the Army Commander and part of his Staff went to Calcutta to plan the next set of operations. Broadly speaking, the directive ordered the Army to seize the line: Mandalay—Pakokku and "exploit to the south." That was very reasonable, eminently sound and possibly within the limited resources available. A mere hope of "exploit to the south" was not, however, quite the feeling in the Fourteenth Army in which everyone from the Commander downwards was determined to have Rangoon, and knew it could and would get it, even with inadequate food and resources of all kinds. The "three-and-a-half pounder plan" (which the ration weighed and the plan was thus christened) complied with the directive in all details. Still, it is strange to record that when, in December, a new directive mentioning Rangoon was received, the original plan required no alterations, certainly not administrative.

One essential of the plan was that the time had come when the Army must cease to be responsible for the vast territorial

area and commitments in its rear that had up till then been its responsibility. In November a new organization, "Headquarters, Line of Communication Command" was set up and took over control of Eastern Bengal, Assam and Manipur State. This freed the Fourteenth Army to deal with Burma only, a country about twice the size of England, Scotland and Wales. During the same month, Headquarters, Allied Land Forces, Southeast Asia (ALFSEA) replaced Headquarters Eleventh Army Group and took complete charge, including administration. XV Corps in the Arakan also left Fourteenth Army and came under direct command of ALFSEA.

During the monsoon, to relieve the administrative strain on the Imphal Plain and to shorten communications where possible, the 17th Indian Division had been moved back to Ranchi, in India, to refit and rest for a short time; the 2d and 7th Indian Divisions were moved down the lines of communication to Kohima, while the 20th Indian Division withdrew to refit in Imphal itself. By the end of November the 11th East African and the 5th Indian Divisions had reached Kalemyo and were then sent out of Burma to rest and refit in an area near Manipur Road.

By 20 December, the 20th Indian and the 2d Division were across the Chindwin and the southern advance on Rangoon had begun. To the north, the 19th Indian Division had crossed the Chindwin early in December in its advance to Pinlebu (120 miles northeast of Kalewa). This Division, fresh to Fourteenth Army methods, was now on full air supply for the first time. In difficult weather and worse terrain it missed or could not accept some of its drops. Not until the Division was clear of the hills and on the Central Burma Plain could it get its full rations.

Administrative Problems

Thus, with the plan in full swing, administration now had to face two problems. The first was the re-equipping of two Indian divisions from the "standard" organization into formations each comprising one air transportable and two fully mechanized brigades. The 17th was in Ranchi and could get a few extra vehicles there, but the great majority had to be drawn from Army reserves in the Manipur Road and other vehicle depots. This was difficult, but was done. This Division came first and was served first. With the vehicle depots thus depleted, the real problem was the mechanizing of the 5th. To do this, practically every vehicle was taken from the 11th East African Division. Their trucks had already been manhandled (with engines racing) down the Kabaw Valley and back, and thus were in a parlous state. All, however, was grist to the mill. The vehicles (and others good, bad and indifferent, begged, borrowed or stolen from line of communication units) were all to start and if necessary be run to death and abandoned.

The other and most difficult problem of all was the maintenance project for the Army when in Burma. Though the transport aircraft would, and did, lift very large tonnages, they could not take it all nor carry the many heavy cargoes that were beyond the capacity of a single Dakota (C-47) or even the larger Commando (C-46) aircraft. It was impossible to build a railway into Burma or even to Imphal. Road and river were thus the only alternatives, and these would have to reach some place in Burma from where roads and rails could radiate when repaired, and which was also within the economic aircraft range of 250 miles from base airfields in India. The very limited Army resources could extend the road from Tamu (fifty miles south of Imphal), where it ended in mid 1944, to Kalewa by using the earth track during the dry weather, during which season an "all-weather" fresh alignment could be made to meet monsoon conditions. The utmost that resources could provide in the Kabaw Valley was tarred sacking. This was

provided in rolls about thirty-four inches wide and laid on a dry, well rammed and drained earth embankment. The edges of the rolls, laid parallel to the length of the road and not across it, were sealed by petrol, heat and a roller. Provided, and here comes the rub, water did not get under the waterproof surface, the result was a fifty mile an hour road. That surface would work as far as just beyond Kalemyo where the gorge began. Resources would permit the construction of an ordinary road cut out of the solid rock from here to Kalewa in the time available.

From Kalewa onwards, there was the Chindwin to cross. This was bridged to allow the advance of the army just after the monsoon and thus provided what was alleged to be the longest floating Bailey bridge ever constructed. As the water level dropped, its length naturally decreased. Any floating bridge, however, was quite out of the question during monsoon conditions when the river, as it ran through gorges, rose sixty feet with an immensely powerful current, and worse cross currents, throughout its length. A permanent bridge would have been a three-year project and then only if the road to the Chindwin and the motor transport available could have carried the load in addition to the maintenance lift.

Across the river there were ten miles of impossible country. It was this belt that had finally defeated all vehicles during the withdrawal from Burma. From the end of this stretch to very near Mandalay was a 200 mile stretch of fair-weather track, still with its tragic reminders of the retreat. Though fair in good weather, it was quite beyond Army resources to make it into a road fit for use in the monsoon. Even then it ended on the wrong side of the Irrawaddy over which the Ava bridge, carrying road and rail into Mandalay and thus to Central and South Burma, had been effectively destroyed during the retreat. So a monsoon road was out of the question. But, by some means or other, apart from the air lift, 500 tons a day had got to be produced in Central Burma by April 1945.

With no rail and a road out of the question, only the Chindwin remained. Boats were the only answer. Trees were unlimited and, at inaccessible Kalewa, mass production began. A few boats sank, but hundreds floated and these were lashed together to provide floating rafts. Loads up to light railway engines had to be carried. Power craft in sections came down the road in tank transporters, heavy outboard motors arrived in ten-ton trucks, lighter ones were flown in. Caulkers were flown in from Calcutta. By April a large fleet was working between Kalewa and Myngyan (fifty miles southwest of Mandalay), the river port in Central Burma where air, road and rail would feed and maintain the troops. The target figure of 500 tons a day, which involved a total craft carrying capacity—full going down and empty returning—of 10,000 tons a day was never attained, but a total of 450 tons was reached.

Loss of Planes

Just as the 2d and 20th Indian Divisions were crossing the Chindwin, the Army received a very sudden and drastic administrative shock. Three American air transport squadrons totalling seventy-five Dakotas, which provided the bulk of the airlift, were withdrawn without warning. They just flew off to China. This all went to show how extraordinary was the whole set up in this unbelievable "theater." These squadrons were under the Supreme Commander, who had allotted them to Fourteenth Army. But all American troops were also under the command of General Wedemeyer—who had relieved General "Joe" Stilwell—who was commander in chief of China, Burma and India. Since General Wedemeyer, who had been Chief of Staff to the Generalissimo for about a year and was then in China,

decided that he wanted these "ships" he just ordered them off. The Supreme Commander did all he could to replace them, but squadrons from the Middle East and home could not arrive overnight. Thanks to the never-forgotten all-out efforts of the remaining squadrons, the troops did not starve, though they were very short for the next two months. The removal of these three squadrons imposed an overall delay of three weeks which was to be bitterly regretted at a later stage.

The advance of the 19th Indian Division clearly surprised the enemy both by its strength and its speed. The Jap thought that the whole of IV Corps was following. It wasn't—but that was the deception plan. Briefly, Headquarters IV Corps was simulated by a big signal layout which sent out a stream of cipher messages and useless communications. In actual fact Corps Headquarters was far away and advancing down the Gangaw Valley, seventy-five miles to the south. The real Corps Headquarters was limited to the number of messages—and the simple codes—that its predecessor, the small Lushai Brigade had used.

Japanese Reaction

The 19th Indian Division advance caused General Kimura to change his plan rapidly. He had just taken over and, unlike his predecessor, was not prepared to fight it out on the Shwebo Plain. Unlike the Germans west of the Rhine, he at once began to withdraw behind the Irrawaddy. The shortage of aircraft has already been mentioned: then the American-Chinese Force in the Myitkyina area, and our own troops in the Arakan, had failed to hold the Jap forces in front of them. These facts involved a big change of plan. Instead of fighting the Jap on the Shwebo Plain (northwest of Mandalay), an essential of the original Army plan, the Jap would now have to be sought out east of the great river and south of Mandalay. Further, his force would now be larger than originally anticipated as he could withdraw with complete impunity almost all his forces opposing Northern Combat Area Command and XV Corps. Hence, the advance of IV Corps down the Gangaw Valley and the deception plan mentioned above.

In this article the phrases "'air landing" and "air dropping" have been used. From the "lift" point of view there is a great difference. Air landing means that the aircraft lands and can therefore deliver a full load, all of which is useful. Aircraft can in fact do more and carry an overload provided this latter is "free-dropped," before landing. Certain commodities, properly packed, can be pushed out without parachute and suffer little damage. When, however, the aircraft cannot land owing to the impossibility of constructing a landing strip on the top of a hill or in thick jungle, then the stores must be air-dropped. This involves a crew of three or four to push out the stores as fast as possible during the short time the aircraft is over the small dropping zone, not to mention the extra weight of the parachute and containers and also their bulk. It also involves a large and highly trained ground organization to "pack" the parachutes and containers. Thus an aircraft on air dropping could only carry about two-thirds of its useful load, an aggregate loss which, with the limited number of aircraft available, the Army could not spare unless operations made any alternative impossible. Once clear of the trackless hills and dense jungle, therefore, all formations had to advance from air strip to air strip. Until the Army reached the plains of Burma and could borrow those made before the war or by the Japs, these strips were made by the troops themselves. First, right in the front line, light air strips were constructed, merely a slight levelling and clearance of the ground, to take the L-5s which took out the casualties to the nearest Dakota strip. Roughly, for every sixty miles of advance one of these latter large

strips were constructed by formations to bring in the supplies as near as possible to the troops. This was essential for the sake of speed and to save the motor transport, much of it now worn out, which soon became irreplaceable owing to the distance replacement vehicles had to come and the tracks over which they had to travel. Nearly always the air strips were merely of bull-dozed earth until it was decided which were really important and worth conserving. The effort necessary to prepare these strips and to face a fighting advance as well can be imagined. In addition, the few army engineers had to construct many other landing strips for the fighter aircraft. Finally, there was the absolute necessity for keeping the radius of action of the Dakotas at 250 miles, since above that the petrol requirement goes up steeply and the useful load that can be carried drops correspondingly. As the Army advanced southwards, therefore, the large air bases in Eastern Bengal had to be moved southwards into the Arakan and even south of that—a vast task magnificently planned and executed by those supporting the Fourteenth Army.

By 5 January 1945, the plan was developing. The 19th Indian Division (pseudo IV Corps) on the left was having a headlong race with the 2d Division (the only completely British formation in the Army) of XXXIII Corps for Shwebo. The former won, and by the 8th it had troops some seventeen miles to the east on the right bank of the Irrawaddy. To the right of the 2d was the 20th Indian Division which captured Budalin on the 6th. Further to the right the real IV Corps (the pseudo Lushai Brigade) which had captured Gangaw, 140 miles west of Mandalay and then withdrawn, chiefly by air, to rest after its stupendous advance, was advancing rapidly down the Gangaw valley. The 7th Indian Division of this Corps, by the 27th of January, had completed the long road move from Kohima and had occupied Pauk after surmounting the most appalling track yet met. Practically all troops south of Kalewa were on air supply. XXXIII Corps and the 19th Indian Division had by then appropriated airfields from the Japs, but IV Corps still had to build its own air strips.

North of Mandalay the Jap was beginning to feel the hammer. The 17th Indian Division had left Ranchi, back in India, and moved by rail to Manipur Road. Its airborne brigade was ferried to Imphal by the line of communication road transport column, while the two motorized brigades moved on through Imphal, down the Kabaw and on through the Gangaw valley, where they joined up with the 255th Tank Brigade in time to give the Jap the biggest shock he had yet received.

Reinforcement

Mention has been made of the additional man-power resources the enemy had collected south of Mandalay. These were seriously to effect the IV Corps. The Army administrative effort was hopelessly overloaded by this time with the troops that were in Burma and on the lines of communication south of Imphal. To meet these extra Japanese forces some extra troops within Burma were necessary. So General Slim said that the 5th Indian Division must come forward at once. This division was resting northeast of Manipur Road. Administratively such a move was not only impossible—it was fantastic. The Division could not be fed in Burma; it could not move on the ancient vehicles it had absorbed from the East African Division; even the roads and tracks could not take it. And so, of course, the division at once began its 700-mile trek to join VI Corps.

The series of crossings of the Irrawaddy began on 19 February with that made by the 19th Indian Division to the east of Shwebo. The crossings were made in succession from the left (or from north to south) and all were based on surprise and

deception. Each one as it occurred misled the enemy into thinking this was the main threat. He guessed wrongly each time and got the right one too late. The crossings were very hazardous in view of the extreme paucity of equipment. Everything was hauled in to help. Bamboo rafts, light country craft, hollowed tree trunks and anything else was used. A considerable number of outboard engines (never very reliable) were available and also many rubber boats. Once again it was as much will power as boats that got the Army over the wide expanse of river, nowhere as narrow as the Rhine, at five widely spaced main crossings. By the end of February, XXXIII Corps' crossings were complete, with three divisions and a tank brigade, all intact, across the great river.

Advance on Meiktila

Farther south, the 7th Indian Division established its bridgehead at Nyaungu. While Kimura was preparing his blow against XXXIII Corps, the Fourteenth Army's real stroke was forming up far away to the southwest. The two mechanized brigades of the 17th Indian Division—the airborne brigade was waiting all ready in Imphal—and the 255th Tank Brigade were concentrated across the river inside the 7th Indian Division's bridgehead by 22 February. The advance on Meiktila began at once and swamped the surprised Japs, mainly administrative units and hospital patients. On the 26th, the first group of the Meiktila airfields was captured, and troops began working feverishly at repairs. At noon next day the airborne brigade began to fly in together with maintenance stores of all kinds. The battle for Meiktila began, starting on a large scale but soon becoming a number of hand-to-hand struggles with a desperate enemy. By 5 March the battle was over.

In Central Burma, Mandalay fell to the 19th Indian Division on 20 March, Maymyo a few days later. Work was at once started on the big project to convert the latter into a first-class rest center for British troops. For many months now even short leave for officers and men had been a big problem. Until the advance into Burma took place it had been possible to send a limited number of men to Calcutta. The facilities here had improved greatly from 1944 onwards, but there was still the long road and railway journey there and back to be faced. The strain and discomfort of the return journey completely nullified any good the few days leave might have done. Once the Army was in Burma, the road link was impossible and only air remained. The fly-out was easy, but the return journey had to count against the transport of other vital things which could not be cut out. Thus, unless a rest center with maximum facilities could be constructed inside Burma, there would be no leave at all for troops. And so, in January, the Rest Camp at Maymyo was planned.

Maymyo, with its delightful climate and English park-like surroundings, provided an ideal setting for a rest center. Every house that was still standing was taken over. By June, some 400 men, for ten days at a time, were enjoying the real rest and change they had so deserved. Officers facilities and clubs came a month or two later.

Just after the fall of Mandalay, another division joined the Army. In May 1944, the 36th Division comprising two British brigades had been lent to General Stilwell for operations southwest of Myitkyina.

The 36th Division did a magnificent job in its advance down the railway corridor on the right flank of the Chinese troops. As their guns could not be flown, the division was given Chinese artillery units. By the end of March 1945, it had advanced too far south to be properly controlled by Northern Combat Area Command. Also

the Chinese had captured Lashio (125 miles to the northeast of Mandalay) and considered their job done and would advance no farther. Thus the 36th Division, then augmented by an Indian brigade, came under command of Fourteenth Army and joined it *via* Maymyo. The Army had no aircraft available to maintain it, so Northern Combat Area Command agreed to lend the necessary aircraft until 1 May. This was an immense help in a difficult time but it meant that, by that date, the Division would have to be flown out of Burma and so, to its own great regret, it could not be deeply committed.

In the meantime, the big task of clearing up communications and other troubles in central Burma was well in hand. By the end of April all roads were passable and almost all gaps bridged. Salvaged engines and trucks were working on various stretches of railway though the full-scale replacement of smashed bridges was not possible. By October 1945, however, there was only one gap between Rangoon and Mandalay. A three-tier Bailey bridge had been constructed over the Myitnge river just south of Mandalay, but this could not take an engine, much less a train. So the loaded wagons, three at a time, were towed across by jeeps fitted with railway wheels. Traffic on the rivers had increased daily, thanks to salvaged tugs and barges, apart from the great flow of Army-made boats from Kalewa. The base at Myingan was developed and stocked to be ready for the fall in air lift during the monsoon, due to begin in May.

Advance on Rangoon

By the beginning of April the Jap remnants, still a considerable force though very disorganized, were trying to break out to the south and east. That was the time for the advance on Rangoon. The administrative position was then desperate. There were six divisions to be maintained, excluding the 36th which was to be flown out in any case. To ease matters a temporary advanced river base had been opened at Monywa until Myingyan was captured and ready (as it was by 1 April) and this took the 150 odd tons a day that could not be floated down from Kalewa. This tonnage was a help, but not much more, as it could not yet be augmented by the large number of barges and few tugs that were being salvaged and repaired at great speed. The air transports were achieving the impossible and the astounding figure of 2,400 tons in a day was reached. This, of course, could not be kept up. Also the monsoon was close and this would put out of action most of the airfields and nearly all the roads—quite apart from making flying conditions very difficult. To provide the means to enable the smallest possible force to get to Rangoon at all, at least another division had to be flown out, and reluctantly the 2d Division was selected, as British troops require a bigger food tonnage. Even after this, resources would clearly not admit advances down both the Mandalay-Pegu road and the riverside road *via* Prome. The former was selected. This was not only a big administrative risk, but also an operational one as the Japs were in considerable strength on either side and, if they discovered it was the only line of advance, they might concentrate all available force against it. Even on this single axis it was only possible to maintain two divisions and a tank brigade south of Meiktila. This was the moment when the three weeks' delay caused by the withdrawal of the American aircraft had its effect. Time was then so short that, to defeat the monsoon, ten to twelve miles a day had to be covered by the advance regardless of the Jap, the need for coordinated attack, or the state of the roads.

Thus no simultaneous advance, however desirable or even essential, could be made down the Irrawaddy axis *via* Prome. But XXXIII Corps had already captured

Magwe and the oilfield area. So it could hardly sit still. Owing to lack of motor transport, a water transport outfit was formed to enable it to advance slowly.

For the final drive to Rangoon, IV Corps had the 5th and 17th Indian Division and the 255th Tank Brigade. This involved various cross movements of several formations, always a tricky business in the middle of operations, but this time carried out without a hitch. These divisions had two motorized brigades each and now the third brigades were similarly equipped by vehicles taken from formations which were shortly to be flown out. The required speed was maintained, and to such a degree that the demoralized enemy withdrew from the port on 1 May before the victorious Army reached Rangoon. On this day the monsoon broke and the rain fell in torrents. On 3 May unoccupied Rangoon was in the hands of XV Corps which had made an unopposed landing from the sea.

To the layman the movement of supplies may seem prosaic and uninteresting, but to the Army transportation officer it is a business replete with interest, even romance. This is because of the unusual and diverse nature of Army matériel, which gives rise to many handling problems, and the knowledge that the arrival of the matériel in the theaters, promptly and in good condition, is a matter of high military importance.

Report of the Chief of Transportation

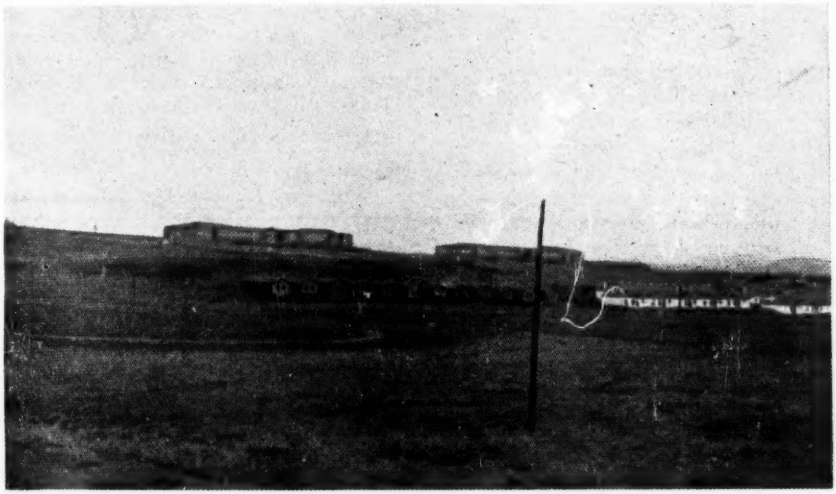
Teaching the Turks

Digested by the MILITARY REVIEW from an article by Lieutenant Colonel J. P. Johnson in "The Journal of the Royal Artillery" (Great Britain) July 1947.

THE background of instruction in the Turkish Army is colored by the influence of a series of German instructors. I have been told by many of my Turkish colleagues that these instructors were officers of great ability, specially selected by the German General Staff, and there is no doubt that their teaching has had a wide effect on the development of Turkish military thought.

In consequence, conditions for students at the Turkish Staff College are much more rigid than they are, for instance, at Camberley, or were at Haifa during the war. Exaggerated importance is placed on deportment and manners. The standard of saluting and standing to attention when speaking to a senior officer has to be seen to be believed, especially when one realizes that the students are officers of between thirty-two and thirty-eight years of age. Original ideas are not encouraged and the Turkish officer student likes his teachers to lay down exact measures, which he then meticulously follows.

Lectures are given in English and translated in phases by the interpreter. Very free use is made of diagrams which practice is always successful. In spite of not being able to speak fluent Turkish, it is very easy to check one's interpreter. This means fair knowledge of Turkish military terms and careful listening. It is a strain, but is well worth while, and it is a minor triumph when one catches the interpreter making a mistake. One difficulty is that the Turkish language is still being changed. Two or three days a week the Government issues orders changing various words which have Arabic roots.



Turkish Staff College, Ankara.

Service with a foreign army is always

interesting, but especially so with so well-disciplined a force as this, so steeped in fighting tradition. In all the military institutions from the Cadet College upwards, Turkish military history is made a major subject. It is fascinating too, and contains many extraordinary feats of arms.

The Staff College itself which was formerly in Ankara is now in Istanbul, where it is housed in the palace of Yildiz, built by the Sultan Abdul Hamil.

The Turks still have cavalry. There is hunting or polo, and the army play their own strange game of "girid" which roughly consists of two sides throwing heavy blunted spears at each other while at full gallop. It is exciting to watch, and dangerous.

Officers who are lucky enough to be stationed in Ankara or Istanbul have every opportunity to indulge in a variety of sport. Near Ankara game of all kinds abound and the closed season for shooting is very short. There is good skiing in Ankara from December to March, an excellent tennis club, and bathing in the local lake. Added attractions in Istanbul are the skiing center of Uludag, the ancient Mount Olympus, on the southern shore of the Sea of Marmara, and unrivalled opportunities for sailing and fishing.

The Turk invariably makes a good pupil. He is patient and attentive. One reason for this is an ingrained reverence for teachers of all kinds. From Mahomet the Conqueror onwards, the Sultans, in spite of all their cruelties and weaknesses, always encouraged learning, and invested the teaching profession with an aura of superiority, which commanded the respect of the nation and still does. This has spread to the fortunate army officer, who is often given credit for far more knowledge than he in fact possesses. However, kindly though the demeanor of students may appear, they long to catch their teacher in any error, and one gets away with few mistakes.

Students at the Staff College are obliged to study two foreign languages during their three-year stay. This is a great help to British instructors as one can normally find someone in each class with a working knowledge of either French, German or English, in that order of likelihood.

Army schools have an influence far beyond the immediate understanding of those who are undergoing instruction. For at these schools is inculcated the doctrine that we of the military profession do not own the Army; rather, the people own the Army, and we are a part of the people. We are here to serve a Nation that represents the greatest human achievement in history. As long as we try to serve the Nation in this spirit, there will be no question of the effectiveness and efficiency of our public relations.

General of the Army Dwight D. Eisenhower